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RIVETING THE PLATES OF A PENSTOCK FOR A HYDRO-ELECTRIC POWER PLANT.—[See page 333.]

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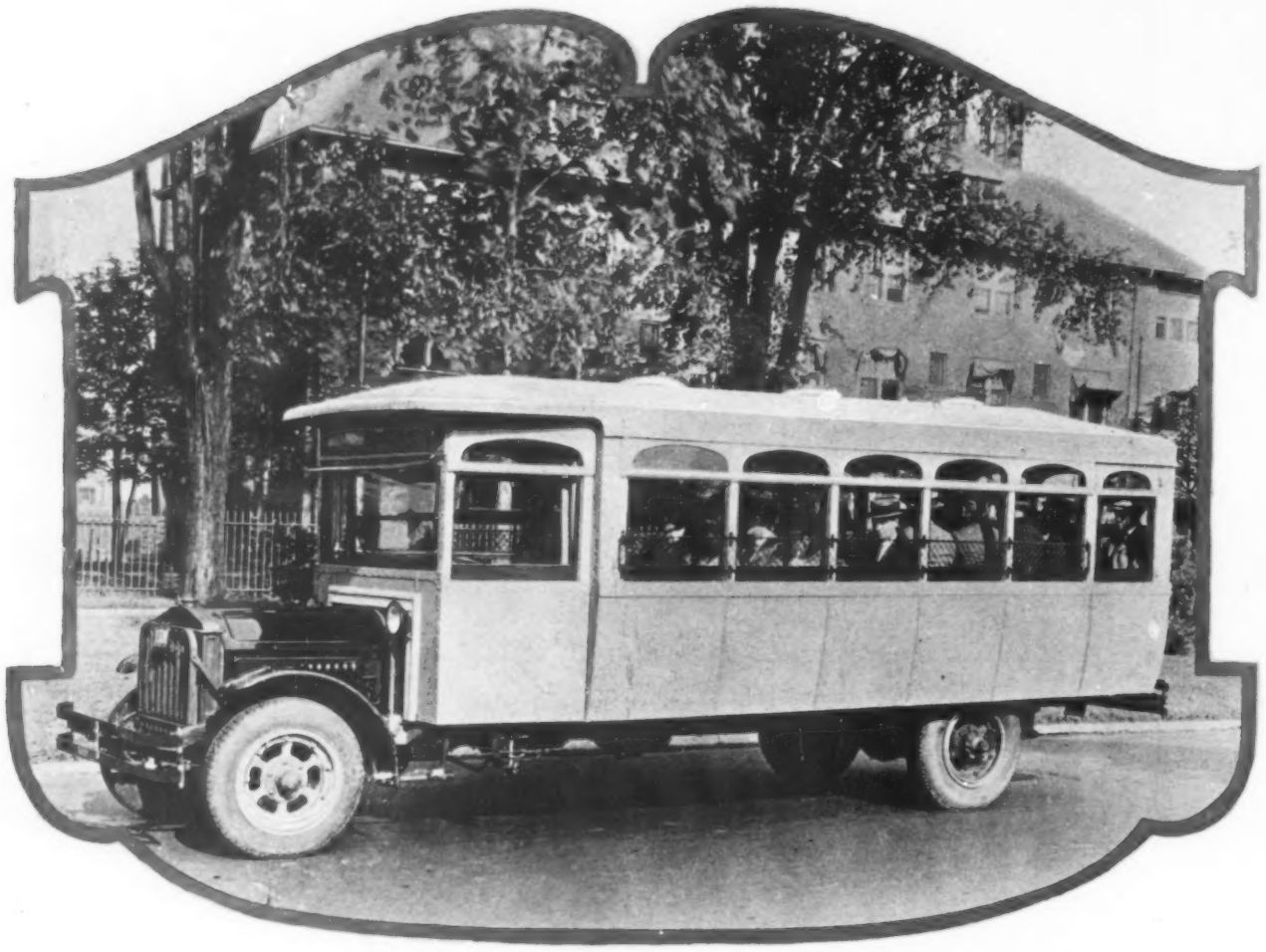

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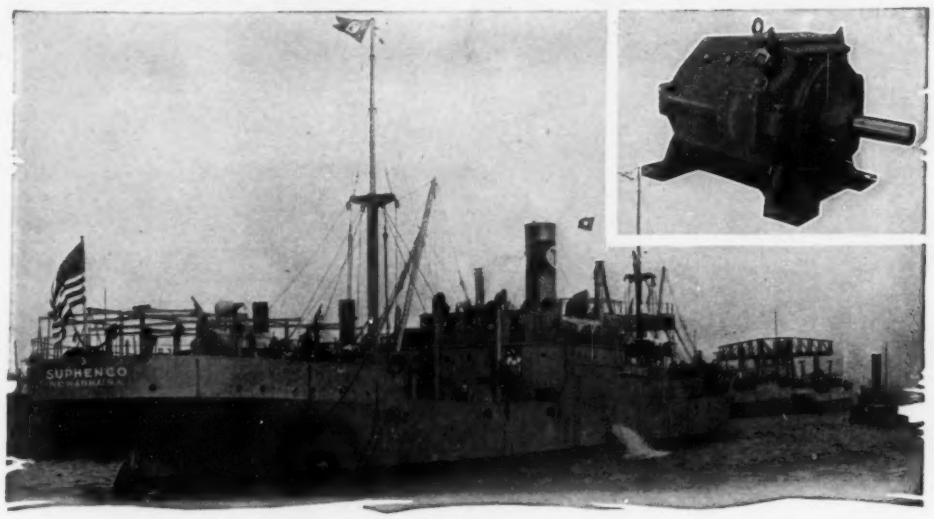

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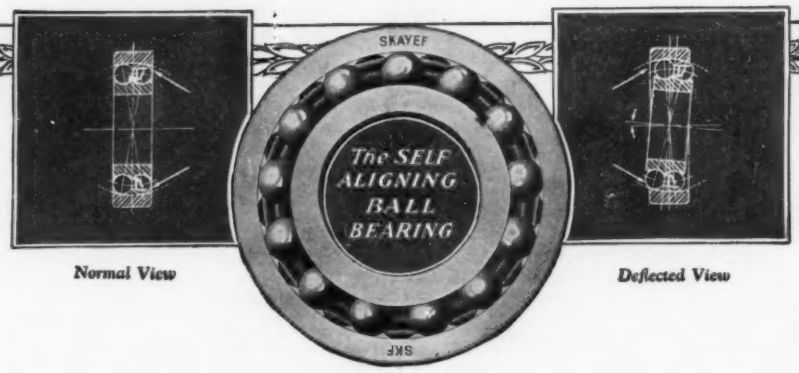

Normal View *Deflected View*

BALL BEARINGS

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With the Editors

THE fiftieth anniversary of that indispensable tool of modern business—the typewriter—was recently celebrated. At the time we carried a full page of typewriter photographs, selected with a view to depicting the progress of this most useful invention. And now we have something more to add to our brief review of typewriter evolution. From the book entitled "History of the Typewriter," by Mares, we learn that "during the years 1847 to 1856, Alfred E. Beach, the editor of the SCIENTIFIC AMERICAN, invented a number of machines. . . . The most noticeable feature which will strike the typist of today is the key-stem passing through the bridge, the bell-crank lever pulling the connecting wire, and the pivoting of the type-levers. With this illustration before him the operator might very well wonder wherein the inventions of the past thirty years have advanced the essential theory of the typewriter. But Beach's machine was not intended as a writer pure and simple. It was used to emboss a narrow paper tape. This tape fed through the center of the machine, and the type-bars themselves worked in pairs like a pair of tongs. When a key was depressed, the lower bar rose, and the upper bar descended, and gripped the paper between them. On one bar the letter was in relief, and in the other it was sunk, so that the paper was forced into the sunken letter by the pressure of the one in relief. The type-bars all converged to a common center, and the paper was fed forward by an independent clockwork mechanism, the escapement of which was controlled by a cord, which, passing beneath the type-bars, received a pull whenever any of them was depressed, and allowed the train of clockwork to advance the paper the space required to emboss the next letter. Thus we have a third state in the evolution of the machine, namely, the equivalent of what we now call the universal bar."

SO once more we rise to bow in acknowledgment. In the past, as in the present and the future, we have not always been satisfied to serve merely as a chronicler of the advance of science. At times we have gone quite beyond the bounds of journalism and have taken a hand in the development of a given invention, either by contributing our ideas and suggestions to the workers in that particular field, or by conducting rigid investigations and studies which have resulted in helpful conclusions, we have every reason to believe.

FOR the present, our psychic investigation and our Abrams electronic reactions investigation are engaging our post-journalistic efforts, so to speak. In this issue will be found an interesting account of how Dr. Geley, the well-known Director of the Institut Metapsychique International of Paris, obtained the famous Franek Kluski wax molds which have attracted so much attention in and out of psychic circles. The original manuscript, written by Dr. Geley in French, his native tongue, has been translated by Mr. Stanley de Brath, a well-known British engineer who has rendered into English such formidable works as Richet's "Thirty Years of Psychic Research." Mr. de Brath has been a close student of psychic research, and our readers are assured of a translation that shall not suffer through any lack of special knowledge of the subject on the part of the translator. Numerous investigators have claimed to duplicate Geley's results, working with inflated rubber gloves. This article, we think, will show that most of these have grossly failed to duplicate the severe test conditions prevailing during the production of the originals.

IN this issue, too, there appears the report of our first formal test of the Electronic Reactions of Abrams method of diagnosis. This first test was of the most elementary character, and we were prepared to follow it up immediately with others surrounded by more difficult conditions. Yet, singularly enough, the electronic reactions diagnostician in this instance, who claims to use the genuine Abrams methods and who certainly makes use of the Abrams "rate" charts and other Abrams technique, all but failed completely in his diagnosis of pure germ cultures. The report makes unusually interesting reading; but it is well to caution the reader that this test must not be considered conclusive. Far more work must yet be done before we can begin to formulate an opinion as regards the merits of the electronic reactions of Abrams diagnosis and treatment.

WE are fortunate in being able to present in this issue two articles on topics of the first importance, which have been written for us by two of the best-known Admirals of our Navy. They are timely, moreover, inasmuch as the anniversary of Theodore Roosevelt's birthday has been set apart this year as Navy Day; and everyone knows that the Navy has never possessed a stauncher and more helpful friend than the great man whom it thus honors. The tribute of Admiral Sims to Roosevelt's influence in building up the Navy, both in its material and personnel, is particularly valuable because of the fact that the Admiral was Naval Aide to the President during the time when notable reforms in target practice, ship design, and so forth, were made; and he speaks with intimate knowledge of the facts. It is quite unnecessary to say anything here of Admiral Sims' record. He was chosen to represent the Navy abroad during the World War, and the great services he rendered in this difficult position are a matter of record.

REAR-ADMIRAL GLEAVES is another naval officer who stood out conspicuously because of his war services; for it was he who, with headquarters at Hoboken, had charge of the great and difficult task of putting two million of our American soldiers across the seas, and bringing them home again after the Armistice. There can be no finer tribute to the Admiral than the remarkably successful way in which this difficult work was done. The Admiral, as our readers will note, has a facile literary pen, and among his best works is a life of Captain Lawrence of the Chesapeake, which should be read by every student of American naval history.

FROM Sir Oliver Lodge's own pen we learn something of the wonders of the atom, with the little universe of its own, in the article entitled "Within the Atom." Sir Oliver has the happy faculty of humanizing science. In this instance he takes the otherwise intricate subject of electrons and protons and converts it into a highly interesting story which may be read by layman and physicist alike. We hope to have other articles from the pen of this great scientist, who, contrary to the general rule, knows how to express himself in a style that is as entertaining as it is understandable to everyone.

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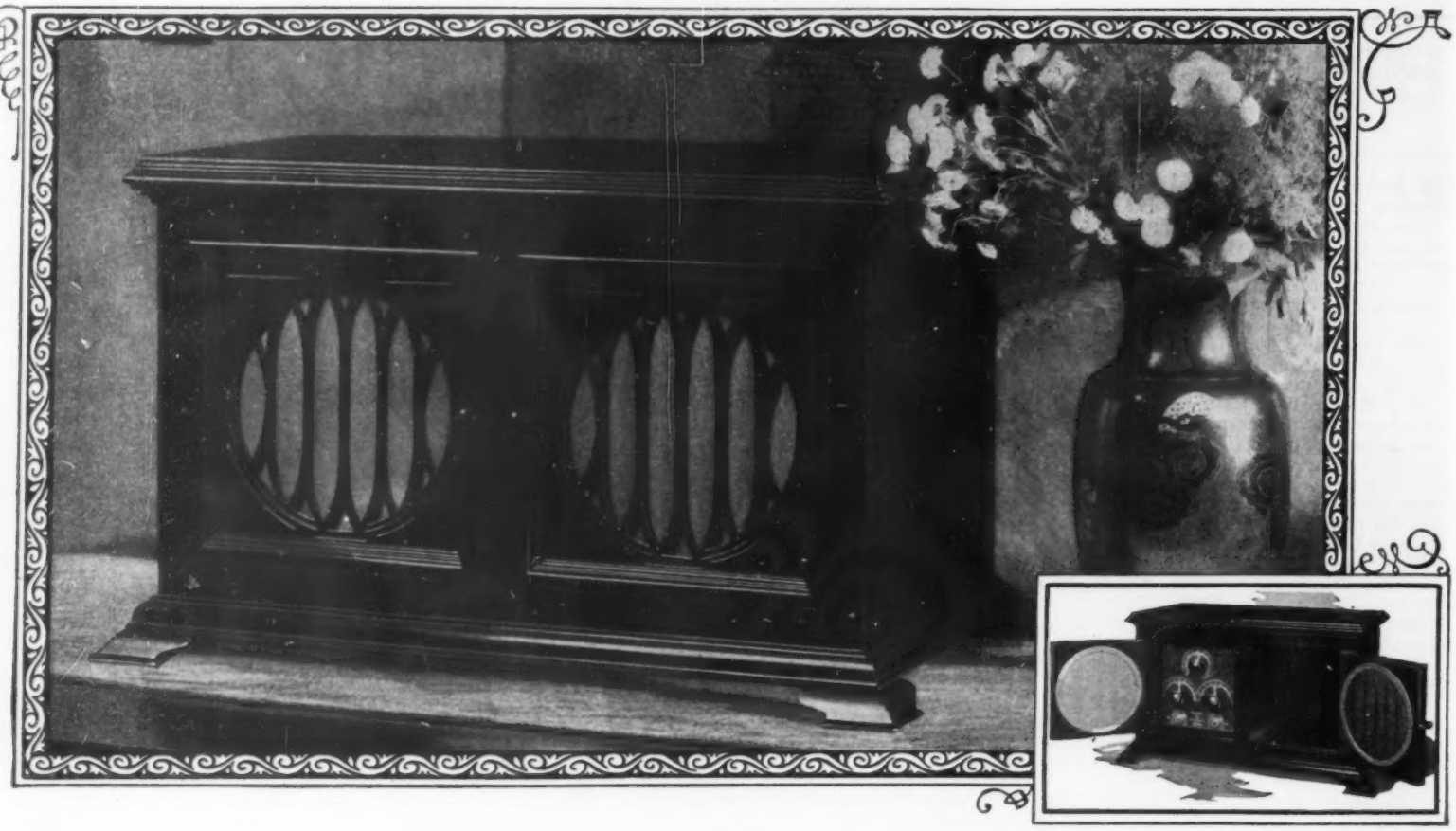

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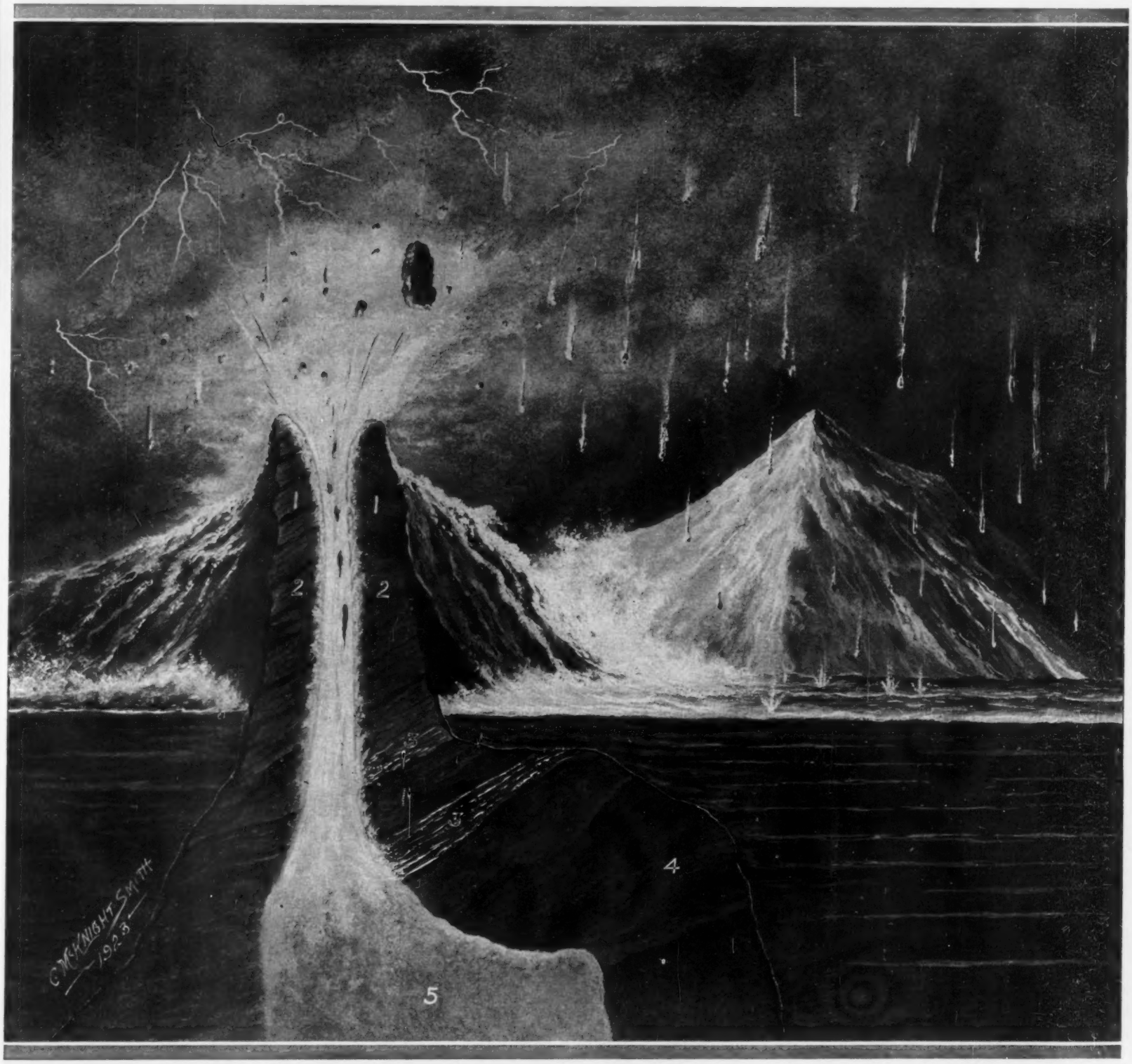
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1923



The mechanics of a volcano: The lava deposited by a former eruption is shown at (1), and the original strata at (2). Water sinking down to the fire reservoir (3) makes the steam of an eruption. (4) is rock which, although very hot, is not molten because of the pressure above it. At (5) the pressure has been released owing to the arching of the layer above, so the rock becomes molten, and out it spouts.—[See pages 304 and 305]

The Drama of Disputed Documents

Some of the Tests by Which the Expert Reveals the Forgery for What It Is

By Edward H. Smith

IN MAY, 1871, was begun, in the Court of Common Pleas of London, the greatest modern trial of a case involving falsifying and forgery. The action had been brought for the purpose of dispossessing the trustees of Sir Alfred Tichborne, minor, in favor of the plaintiff, who proclaimed himself to be the long missing Roger Charles Doughty Tichborne and rightful heir to the large estates of "his" father. The trial of this civil action and the resulting criminal prosecution of the claimant required all of three years, consumed enormous sums and brought the principals world-wide notoriety. It put upon the musty court records of the day one of the strange and abiding romances of crime.

Having been crossed in love through an unrequited passion for his cousin, the young heir to the baronetcy of Tichborne set out from England in 1853 for the antipodes. His ship, the "Bella," touched at Rio and put down to sea from there, to return no more. Tichborne and all his mates of the voyage went down to the dark ports of the missing, and in due time the British courts in chancery determined his death and fixed the succession of the title and estates.

Only the young nobleman's mother clung with plaintive pertinacity to a belief, a hope, that he might have survived. Seas and the fates of men are never too cruel for the wrung maternal heart. Lady Tichborne continued to search for her lost son, mainly by asking acquaintances bound for Australia and New Zealand to seek for news of him. In 1865 a man named Cubitt established a "Missing Friends Office" in Sydney and announced this fact in the London *Times*. Cubitt soon heard from Lady Tichborne and undertook to find her son. In the first months of 1866 she began to receive letters from a man who set himself up as the missing Roger and recited some of his adventures since leaving London in 1853. He told of the shipwreck, his providential rescue, his eventual arrival in Australia, his trials and his wanderings. And though he made many mistakes and palpable blunders, the bereaved mother declined to see any fault in him and accepted him unreservedly as her vanished son.

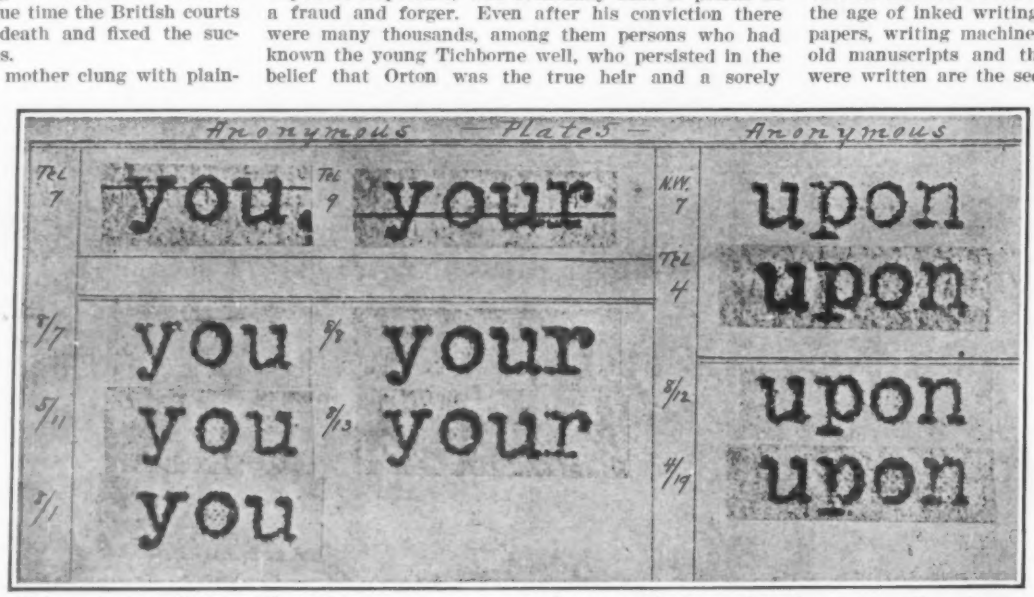
In response to her urgings, the Tichborne claimant went to London in 1866 and began preparing for an action against the trustees under the old baronet's will, made when the son was supposed to be dead. He spent more than five years in these preparations, not beginning his suit until 1871. How he spent this time was developed at the two trials.

The claimant was in reality the son of a Wapping butcher, by name Arthur Orton. He had gone to Australia the year after young Tichborne had set out on his fatal voyage. In the antipodes Orton had suffered every manner of reverse and impoverishment. Finally, more in jest than earnest, he began to pass himself off as the Tichborne heir. Later came the idea of making a grave pretension and trying to win the estate and title. Orton was a gross-looking fellow of common education. The man he was trying to impersonate was a British gentleman who had been primarily educated in France and knew his French better than his English.

These heavy obstacles seemed not to daunt Orton at all. He determined to make himself act, talk and write like a gentleman. By some means he got hold of samples of the real Tichborne heir's handwriting and set himself the task of learning to imitate it. His letters to Lady Tichborne reveal the extent of his success and the depth of his failure.

After what must have been prodigious labor, unrelenting discipline and unremitting devotion, this common and practically unlettered fellow was able to reproduce the handwriting of a tenderly reared and over-sensitive young lord with almost uncanny fidelity. Orton got not only the obvious peculiarities of the Tichborne handwriting but managed by some strange adaptiveness of mentality to achieve what must be recognized as the nervous and psychological characteristics, a feat which handwriting technicians everywhere will recognize as next to impossible. The false heir even learned to misspell just such words as the young baronet wrote amiss, because his principal education had been in French, no doubt. But what Arthur Orton, the cockney, could not do was to follow the phrasing characteristic of the man into whose life and identity he was trying to substitute himself. Tichborne habitually thought in French and translated into English when writing letters, so that his epistles teemed with badly disguised French idioms. These were absent from the Orton letters and it was by this deficiency that the experts of that day fastened the fraud upon him.

The man who conceived and very nearly carried to triumph this great impersonation, this astounding and impudent imposture, was eventually sent to prison as a fraud and forger. Even after his conviction there were many thousands, among them persons who had known the young Tichborne well, who persisted in the belief that Orton was the true heir and a sorely wronged man. Not until a good many years later, when poverty induced him to write his full confession for a London publication, was the doubt entirely cleared.



Enlarged typewritten words taken from an anonymous letter and juxtaposed to the same words written on the suspected typewriter. Note the absolute uniformity

This world famous case may well serve as an introduction to the subject of the evergreen contest between the falsifiers of documents and the experts in questioned instruments of every kind, surely one of the most absorbing matches of wits between the man of society and the man of crime.

Falsification of various legal instruments is, of course, extremely old. Erasures have been found in the Nilotic papyri, which apparently admit of no interpretation save that of fraud. The even earlier cuneiform writings on the clays of Babylon were so carefully protected by special clay envelopes, which would have had to be broken before the writing on the inner tablet could have been changed, and so elaborately provided with seals and the signatures of witnesses as to make it apparent that even the men who did the oldest writing ever discovered were cognizant of the forger and his methods. Classic and early Christian manuscripts, particularly those of a religious character, have notoriously been altered and defaced again and again.

Today fraud and falsification extend to every human article of value or interest. Copied works of art, old palimpsests made to order, false signatures on pictures, fraudulent incunabula, forged autographs and spurious original manuscripts are being offered and sold every day. Literary impostures are common as air, though the art has fallen upon evil ways since the day of Macpherson and his Ossian poems and Chatterton with his heartbreaking Rowley parchments, "recovered from the Redcliffe muniment chest."

Now, alas, no one bothers to palm off beautifully done verse as translations of Third Century Gaelic or the creation of a Fifteenth Century Monk. Indeed, the main trend of falsifying and forging runs afar from the shining and perilous fields of art. In consonance with the modern taste, it finds its way among the marts and places of business. As a result we have now more to do with false wills, bonds, legal conveyances and account books. An enormous total of money is got every year by such devices—tens of millions, past question. And were it not for the perfection to which the modern technician in authenticity has carried his work and his art, the loot of the forgers would assuredly be ten times as great. Here is where the modern contest begins between the expert in hand and typewriting and the criminal who makes this field the scene of his artifices.

The problem of instrument falsification and detection rests fundamentally upon four materials—paper, ink, removers and restorers. Typewriters, enlarging cameras, delicate instruments for measuring loops and pothooks, micrometers, straightedges, high powered microscopes, various chemicals used in analysis, reagents for testing the age of inked writing and much knowledge of inks, papers, writing machines, handwriting, characteristics, old manuscripts and the materials with which they were written are the secondary forces which figure in the matter.

Ink is the stuff of prime interest. In former times all ink was gallate of iron, a substance which turned black slowly, after shorter or longer exposure to the air. Gallate of iron is still the basis of all commercial inks now used in the United States, but today more and more auxiliary substances are being used in combination with the iron base, for the purpose of giving the writing an immediate "good color." What happens to the iron of the ink after some exposure to the air is exactly what befalls a steel blade when air and moisture strike it — oxidation. Weathering deposits a red oxide of iron on the steel. It turns the gallate of iron into black oxide. Hence all iron inks turn blacker as they grow older, while the auxiliary colors gradually fade. There is, however, a limit upon the process of blackening. At the end of about eight years the oxidation is complete and no further change is observable.

This matter of the slow oxidation of commercial inks is the basis for one of the most interesting feats performed by the experts who use their science for the defeat of criminals. An ink-written document submitted to them any time under eight years can be chemically treated and the date at which it was written determined within very narrow limits. This bit of the expert's technique has been found of almost limitless usefulness in connection with the doctored books so often employed in bankruptcy cases. For instance:

Recently a firm of clothing merchants failed, owing its creditors a very large sum of money for goods purchased within a month or six weeks of the bankruptcy declaration. When the case was brought before the referee it was found that only one account book remained. It covered a period of about six months previous to the debacle. All the older records had, according to the claim of the bankrupts, been either accidentally destroyed or purposely discarded after the new set of accounts had been opened.

This single account book showed disbursements of various kinds, including the repayment of private loans, which brought the affairs of the concern to a seeming balance. In other words, the book version of the concern's affairs cleared the merchants of any appearance of fraud and showed forth evidence of the reason for failure. The creditors, however, had good reason for believing that this book was doctored. The very fact that the older records could not be produced was considered ample ground for the suspicion that this one

account book had been speedily and fictively prepared, just before the breakup. Such practices are, of course, very common. They are one of the principal bases of the crime of fraudulent bankruptcy which, according to the National Association of Credit Men, costs the honest wholesalers and manufacturers of the country about 400 millions a year in losses.

There was added reason for suspicion in this sole book of accounts. It was to be noted that all the entries in it were written in the same ink and by the same hand. Moreover, there was so slight variation in the handwriting of the bookkeeper that the work had the appearance of having been written at one sitting, it being a well understood fact that no man or woman writes precisely alike at any two times. Mood, the state of health, the weather, the position while writing, the psychological state of the writer—all these vary constantly and affect the character of the writing slightly but obviously enough for the expert eye.

But suspicions are of no account in court. Unless something more tangible could be developed, this book would have to stand before the referee and the claims of the bankrupts would likely be confirmed. The book was, accordingly, taken to that veteran examiner of questioned documents, Mr. David N. Carvalho, who has been the chief American exponent of the art for fifty years and official expert of the district attorney's office for most of that long term of service. Mr. Carvalho tested the ink on the first page of the book and the ink of the last. He found that the oxidation had progressed almost equally in both samples. Also, he discovered from the degree of oxidation, that the writing had all been done within a period of ten or fifteen days and not more than 20 to 30 days before the bankruptcy. Ergo, the entries had all been written at about the same time, they had not been made on the dates indicated and they were, therefore, fictitious. It was later discovered that the book had not been bought until several months after the date of the first entries. The fraud was thus established.

Falsified account books are coming to interest the handwriting technician more and more every year, as the practice of "doctoring" accounts and falsifying entries spreads over the country.

The matter of ink removers is one I discussed some months ago in connection with check forgery and alteration. It is as well, however, to repeat the fundamentals of the question here. All inks, being comparatively simple chemical compounds, may be broken down by chemical means. The exception is made of aniline inks, which have no known chemical affinities. These inks may, however, be instantly removed with a little water or a lick of the tongue. There are acid-proof inks, and these have been largely advertised by the makers of check writing mechanisms. But it must be noted immediately that "acid-proof" is a term of obfuscation and deception. Such inks resist the common acids well enough, but they do not resist a combination of acid and alkali, which is what everyone uses as a remover. Even the common ink remover which can be bought in any drug or stationery store makes swift mock of such pretentious combinations.

These commercial ink removers are, as everyone knows, contained in two little bottles and ordinarily labeled No. 1 and No. 2, indicating the order of their application. No. 1 is usually a slightly red liquid, a 20 per cent solution of acetic acid. No. 2, the white or clear liquid is a 10 per cent solution of chlorinate of lime or soda. The chlorinate, contacting with the acid, gives off chlorine gas, a very effective bleach of almost anything. This gas immediately changes the black oxide of iron in the ink into white oxide and the writing disappears, as the bleach also takes the other colors from the writing fluid. Expert forgers are acquainted, of course, with stronger removers than this, but the same principle underlies them all. The fact worth remembering is that nothing is actually removed by this process. The chemicals which give the ink its black color are simply whitened and made invisible. They remain in and on the paper. Therefore, they can be restored.

The criminal, unless he is a man of technical education, usually fails to understand this and goes blithely ahead with his liquid deletives. Then his work comes under the eye of the expert. A simple and easy application of other chemicals, such as the hydro-sulfuret of ammonium, to mention only one, immediately brings the "removed" writing to sight—in deep yellow lines instead of black. The white iron oxide has been converted into a sulfate and is as clearly legible as ever. This test has often been made in court, in the presence of juries, with startling effect and usually sad results to the perpetrators of fraud.

It frequently happens that men who plan frauds of this kind try to anticipate the expert by causing the original documents to be written in aniline inks, which are then removed with the tongue or a wet sponge. Naturally, these inks and this form of removing leaves little or no trace and the writing cannot be restored chemically. But the expert has still a method of circumventing the crook. All paper of modern type is calendered, which means that it is ironed or finished between hot rollers. If a drop of water or fluid chemical touches the paper thereafter, the ironed surface is disturbed and softened. Even if a long period of time elapses, this blemish remains. The expert finds erasures of this type by submitting the entire writing to the fumes of iodine. Wherever a paper has been so erased the iodine fumes cause it to turn blue and to begin to show the previously invisible pen wounds or cuts in the paper pulp. Such blue spots are then lightly dusted with lamp black and the original writing may then be clearly seen.

It must not be supposed that the criminal who falsifies handwriting confines himself to offenses against property. Money, goods, wealth—these are, of course, the root of his motivation, but often enough the criminal must use murder as a weapon to his end. Most older readers will remember the celebrated Patrick murder trial and cannot have quite forgotten the great part played in it by the problems of forgery and handwriting.

According to the case laid down by the prosecution, Albert T. Patrick, an inconspicuous New York lawyer, came to be slightly acquainted with William Marsh Rice, a multi-millionaire capitalist who had come from Texas, and conspired with Rice's valet, Jones, to draw a false will, execute some checks in Patrick's favor and write Patrick a number of letters, which could be produced to show that Rice and Patrick were intimate friends. Patrick knew enough to have the letters and the will written on a typewriter in Rice's apartment by Jones, who also did his master's secretarial work. He then had Jones study Rice's handwriting, so that he might be able to forge the old millionaire's signature to the various instruments.

Probably there was no original intention to murder Rice, who was 81 years old, very feeble and appeared likely to die at any moment. But extraneous events forced the conspirators to desperate action. The old man was first weakened with doses of mercurial pills and finally killed with chloroform, which was placed over his face in a towel cone while he slept.

Jones, however, made two mistakes. In writing out one of the large checks made payable to Patrick he wrote the lawyer's name "Abert" instead of "Albert." This blunder was found by the bank teller, who refused to sign the check and tried to communicate with Rice. This slip caused the interruption of the plan for cremating the body and thus destroying the evidence of murder.

The second mistake made by Jones is one common to forgers of signatures on wills and other instruments. Jones had evidently got one of Rice's genuine signatures and begun tracing it or copying it—probably the former. He overlooked that fact that a man seldom writes his signature in precisely the same way and very rarely in the same size. But all the signatures on the letters to Patrick, the checks, the request for the cremation and the will itself were of equal bigness and deadly similarity. The forgery was apparent.

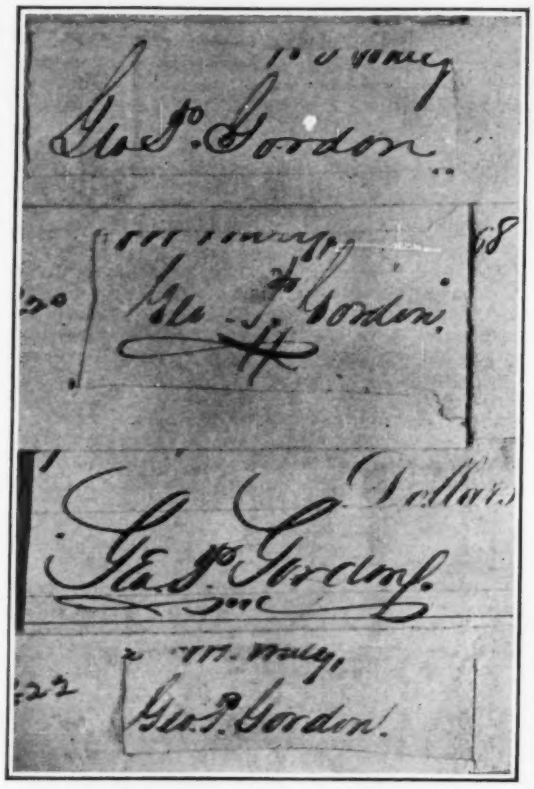
Patrick was convicted on the strength of these handwriting revelations and the testimony of Jones, who became a state's witness. Patrick lay in the shadow of the electric chair for four years and was finally pardoned, largely because of the uncertainty of medical testimony.

Typewriting presents special problems to the concealer and the expert. Almost everyone knows, by this time, that writing machines have their individualities like human beings. No two machines, even though they be of the same make and model and operated by the same person, using similar ribbons and paper, will turn out work that does not show clear distinctions, one piece from the other. Even if some of the type keys are changed after a fraudulent document has been written on a machine, this fact can be developed and proved. Or, if all the keys are removed and new ones substituted throughout, the expert is likely to find peculiarities due to the roller or some mechanical imperfection. If he does this, he can also find out where the old keys were removed and the new substituted. Thus the only safety for the criminal is to break up the machine completely and dispose of it in some sure and secret way. All these facts are more or less widely known among sharpers of every stripe.

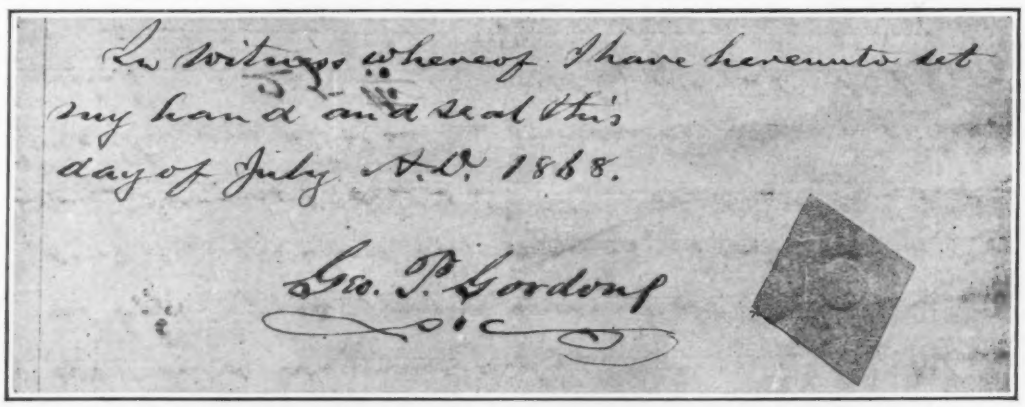
What is much less familiar to the public and the crook is the fact that typewriting has its nervous and psychological, as well as its physical peculiarities. The expert can tell whether a piece of typing has been done by a person who uses the "touch system" or the visual method, whether the writer uses two fingers or three or all, whether the writer is calm or excited, and so on. Each operator uses a machine a little differently, spaces individually, uses various keys for special purposes, etc.

Mr. C. D. West, the veteran investigator of the National Association of Credit Men ran down one of the most celebrated of credit swindlers through pecularities in typing. This man was in the habit of opening women's wear and specialty shops in various towns and

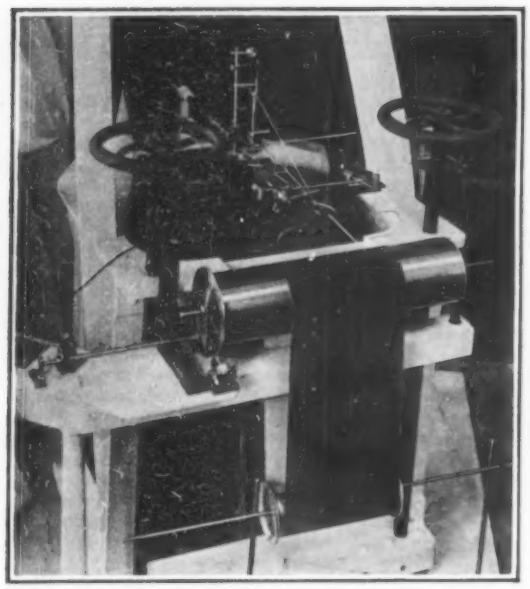
(*Continued on page 369*)



Genuine signatures of the late George P. Gordon, showing that he never wrote his name in the same size, that he used the pothook at the end only once and the scroll underneath when he thought of it



The last clause of the spurious will of George P. Gordon, showing the spurious signature with the pothook at the end and the uncertain, obviously copied scroll underneath



Largest seismograph in this country, installed in New York City. This is a close-up view of one of the recording members

Earthquakes and Volcanoes

The Mechanics of These Titanic Subterranean Forces and Their Destructive Careers

By Edgar W. Woolard

Division of Seismological Investigations, U. S. Weather Bureau

VOLCANOES and earthquakes afford spectacular and impressive manifestations of the titanic subterranean forces which are still at work on the fashioning of our globe; the cataclysms and upheavals accompanying their operations have occasioned the most terrible disasters which have befallen mankind. Catastrophe after catastrophe of this nature has marked the course of history; but never, perhaps, one so great as that which at noon on September 1 laid in ruins two of the principal cities of Japan and took a toll of about 200,000 lives. And as the Japanese people, like all peoples before them similarly stricken, turn quickly to the work of reconstruction, we wonder at the exhibition at once of man's feebleness and his greatness in the face of these appalling forces of nature.

Mastery over the effects of these natural forces comes only through a thorough understanding of their operations. Unfortunately, our views concerning the ultimate causes of volcanic and seismic phenomena are distinctly less confident than were those of previous generations. The "molten interior" of the earth and the dying "internal fires"—supposed heritages from that far-off age when the earth was born from the primal nebula—as the source of internal heat and of volcanic outbreaks have been banished from textbooks of geology, and their place has not been filled to complete satisfaction. Again, the simple conception of a cooling and therefore shrinking interior, overlain by a cold outer shell which becomes deeply wrinkled as the earth continues to contract, has been found inadequate fully to explain the origin of the forces which build mountains and cause the solid earth to tremble.

General Structure of the Earth

Several lines of evidence point to the fact that the earth is solid throughout, and about as rigid as steel. On the other hand, observations in mines and deep borings leave no doubt but that at comparatively moderate depths within the earth the temperature must exceed the melting points of all known substances. However, most substances, and probably all ordinary rocks, expand in passing from the solid to the liquid condition. For this reason, liquefaction is opposed by pressure, and a much higher temperature is necessary to melt a rock subjected to great pressure. Hence the tremendous and ever-increasing pressures within the earth keep the material in the solid state. At the same time, these very pressures soon exceed the crushing strength of any known substance. At a depth of from 12 to 15 miles the rocks must be reduced to a state where they *flow* under stress, like putty or tar, instead of fracturing or crumbling. In short, the pressures and temperatures within the earth reduce the rocks to a state like neither the solids nor the liquids with which we are familiar.

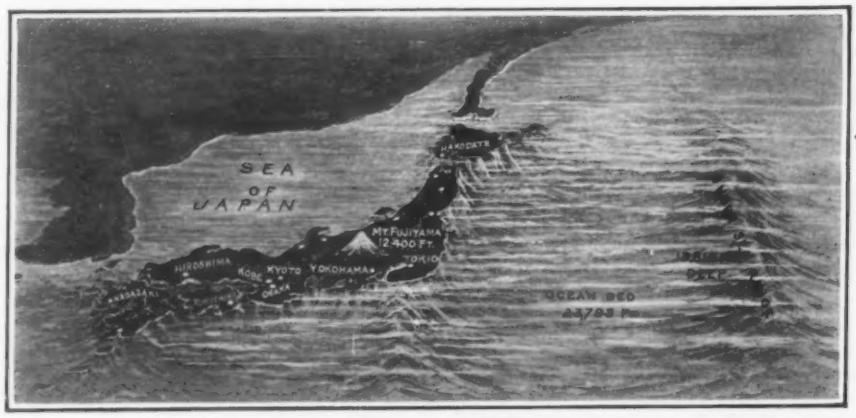
This part of the earth grades above into the outer brittle shell, where an increasing stress will in time result in the fracturing of the rock and the bodily displacement of blocks of the earth's crust along the break, or *fault*, as the geologist calls it. The stresses brought to bear upon the crust of the earth have been, and are still being, relieved by constant slow movements up and down, by warping, folding, faulting and dislocation, of the rocks of the crust, and by continual readjustments within the earth. Rock strata, the structure and contents of which prove them to have been originally horizontal sheets of sediments deposited at the bottom of the ocean, are now found at all elevations up to the tops of high mountains, sharply folded, and traversed by extensive faults, often hundreds of miles in length, along some of which thousands of feet of slipping has taken place. Great belts of weakness have been developed in the crust along which the major deformations have taken place.

Volcanic and Seismic Phenomena

Earthquakes and volcanoes are inevitable accompaniments of the above processes of earth deformation.

The immediate character of earthquakes has long been established as a form of undulatory motion in the more or less elastic rocky crust of the earth, originated by some sudden impulse or disturbance in the substance of the earth, much as a bowl of jelly might be set in vibration by a smart tap on the side of the vessel. In many cases, as in the California earthquake of 1906, the shock is accompanied by visible fractures and displacements of the solid rock; the disturbance reaches its climax close by the fracture. In other cases no actual faulting is visible at the surface, the whole of the slipping having taken place some miles below the surface. However, we have here only the beginning of the story, for we need to know what causes the fracture that gives rise to the quake, and this problem has not yet been fully solved.

Similarly, the investigation of vulcanism has raised a wide range of problems, most of which still await solution. Just why volcanoes erupt, we do not know. The average density of lava differs little from that of the surface rocks, indicating that such material does not come from a great depth. If, in the various movements and deformations of the crust, the pressure should be relieved at some point within, melting would dubtless occur, and a body of molten magma be formed; but no satisfactory reason for its ascension can be assigned. The generation of steam appears to have much to do with volcanic processes, and the fact that almost all active volcanoes are situated in, or relatively near, the sea, or near lakes, has led some to believe in a necessary connection between volcanic activity and surface waters. But it is now generally believed that the steam is generated from water or other materials which have always been present in the depths of the earth.



Bird's-eye view of Japan, showing how the islands are formed by the tops of mountains which rise out of the sea

Earthquakes

The seismic regions of the earth are those in which extensive layers of rock of great thickness have been intensely folded, dislocated and elevated when the principal existing mountain chains were born. They occur in great bands, marking the lines of weakness in the crust, and generally following the lines of elevation which bound the huge oceanic basins—regions of recent, or in some cases still continuing, mountain growth. The rocks are held by friction and pressure under increasing stresses until they yield. Slipping suddenly, they communicate an elastic shock or jar to the crust of the earth, and vibrations spread out in all directions, with velocities of several miles per second. The vibratory motions, together with the sudden displacements and buckling of the ground, may cause general destruction over a wide area. Alarming sounds issue from the bowels of the earth; and if the quake occurs near or underneath the ocean, it is followed by a series of great sea waves (popularly misnamed "tidal waves") called *tsunamis* by the Japanese, which travel across the oceans at the rate of 300 to 500 miles an hour. A strong quake is invariably followed by a great number—usually hundreds—of weaker shocks.

Earthquakes are not always due to a single fracture or close-set group of fractures; they sometimes have very complex origins. Oldham has concluded that the faulting to which the destructive shocks are due is the secondary result of an extensive readjustment of some kind 50 to 300 miles below the surface. It is possible that minor factors may contribute to the determination of the exact moment at which a stress near the breaking point will be relieved by fracture; thus Omori has found an apparent connection between rainfall and earthquake frequency in northern Japan; and several investigators have found similar connections between earthquakes and barometric pressure: a quake may be set off by an additional weight of air and water on the land.

The permanent changes of position of the ground in violent quakes take place simultaneously in opposite directions on either side of the fault, and decrease in magnitude with increasing distance from the break until they cease to be measurable at a distance of several miles. The displacements, often amounting to 10 or 20 feet or more, may be horizontal, vertical, or both. This movement on opposite sides of the fracture in opposite directions is characteristic of the disruption of materials under stress, and quite in accord with dynamical principles.

When shocks are frequent and slight in a seismic region, the stress is constantly being relieved, and there is less danger of a heavy quake; where quiet has reigned for some time, the shock which eventually comes is likely to be severe.

Earthquakes due to disturbances in connection with volcanic operations also occur, but, while often severe locally, seldom are noticeable more than a few miles from their origins. Tremors occasioned by the collapse of underground caverns are likewise local and unimportant. The tectonic quakes, however, i.e., those due to faulting of the rocks or to intermittent slipping along breaks already formed, may completely devastate hundreds of square miles of territory, and send vibrations through the entire globe.

The vibrations or elastic waves which spread out through the globe from the *focus*, or seat of initial disturbance, may be recorded by means of instruments known as seismographs. (The measurement of the great lurches of the ground near the origin of a violent quake is beyond the capacity of any instrument.) The general principle of all seismographs consists in having a heavy mass of metal arranged in the form of either a horizontal or an inverted pendulum, so that its inertia prevents it from partaking readily of the motion of the earth when the latter is shaken. A pen or stylus is so connected as to trace a record, greatly magnified, of the relative movement between the pendulum and the earth on a sheet of paper carried along by clockwork.

Two principal sets of earth vibrations are generated

during an earthquake. One set travels round the earth, in the crust, while the other goes through the interior of the earth; the latter set, again, is compounded of two species of vibrations superposed—one longitudinal (like sound waves in air), the other transverse (like light waves in the ether). The three kinds start out from the focus simultaneously, of course; but those which travel *through* the earth are registered first at a distant point, not only because they have not so far to travel, but also because they are propagated at a much greater speed. Furthermore, the longitudinal vibrations (*primary* waves, or first preliminaries, as they are called) travel faster than the transverse (*secondary* waves, or second preliminaries). Hence the three kinds of waves arrive at a distant point each at a different instant, and each traces waves of a different shape on the seismograph record.

A destructive quake is usually registered by seismographs all over the world; at a distant point, the seismograph often continues to record small vibrations for two or three hours. The study of the records of numerous quakes has made it possible, by noting the intervals between the arrival of the different types of waves, to draw curves showing the time taken by the various waves to travel given distances, and to construct tables from which the *distance* of the region lying above the focus (the *epicenter*) can be determined for any point at which a seismogram has been obtained. At most, only a guess can be made as to the actual *location* of the quake, however, unless the distances from *three* stations have been determined. Then it is a simple problem to locate the quake exactly by drawing circles on a globe with these distances as radii and the stations as centers, and noting where the three circles intersect.

An earthquake is felt in some part of the world on an average of 4000 times yearly. In the United States alone, a hundred or more occur each year. Many tremors, occurring over small areas, are undoubtedly missed; and others, too faint to be sensible, are registered by the seismographs. Our globe is trembling somewhere practically all the time. Milne estimates the total annual output from all sources to be 60,000 quakes. Fortunately, the great majority of these are feeble and harmless, or else occur under the sea or in thinly populated districts. According to Milne, only 4151 *destructive* quakes occurred between 7 A. D. and 1899.

Japanese Earthquakes

The most unstable region of the earth at the present time is that along the western margin of the Pacific. It was in Japan, probably the most seismic region of the globe, that seismology as a science was born, about 40 years ago, through the pioneer work of the British scientists J. Milne, J. A. Ewing and T. Gray. The earthquakes of the Japanese Empire have been studied more carefully than those of any other country.

The Japanese islands are arranged in the form of a festoon, with its convexity facing the Pacific Ocean, and, as in similar groups of islands and in mountain-chains of the same form, the convex side slopes more steeply than the other. The Japan Sea to the west is shallow, but on the Pacific side, between the Japan coast and the Kurile Islands, the ground plunges down into the great Tuscarora Deep to a depth of nearly 27,000 feet within 110 to 240 miles of the coast! The earthquakes of Japan follow a law which is general in such cases: they are most numerous and violent on this steep slope. During the 21 years 1885-1905, for every strong quake originating on the concave side of the islands, there were 16 on the Pacific side.

Earth tremors are a matter of daily routine for the Japanese people, 12,700 having been recorded in the ten years 1885-1894, while from 1902 to 1907 the average annual number was 1605. However, from 1601 to 1898, only 108 *destructive* quakes visited the country—one on an average of every 2¾ years—and only a few of these rank as outstanding disasters. The quake of 1703 is reported to have cost 200,000 lives. In the Mino-Owari disaster of 1891, 7000 perished.

Grievously as Japan has suffered from earthquakes and their effects in the past, the devastating shock of September 1 probably surpasses all previous disasters, although we have as yet only incompete reports and no scientific observations. The Osaka observatory places the epicenter in the Izu Peninsula. The shock was violently destructive over an area extending 100 miles from north to south and 130 miles from east to west, and having a population of about 7,000,000.

Earthquake regions of the Western Hemisphere, shown in black

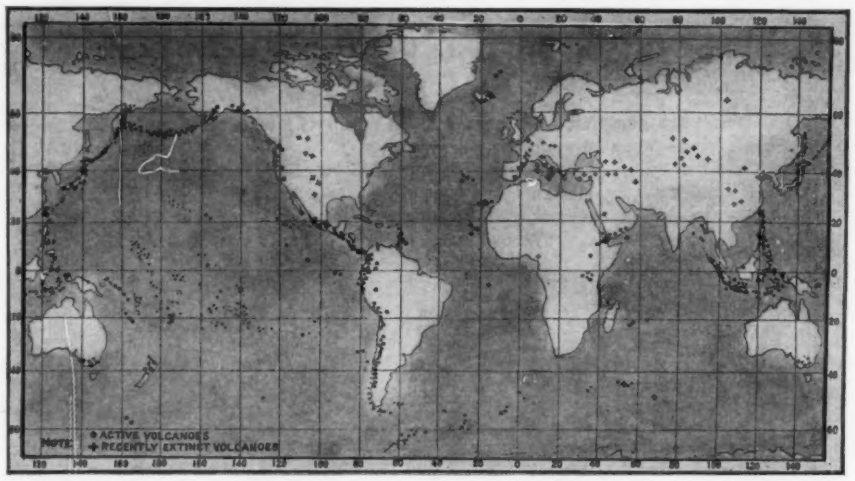
Other Great Earthquakes

Space will not permit of even an enumeration of all the great earthquakes of the past, but we may mention a few of the more notable. Tremendous losses of life are reported in connection with some early quakes. Thus, in India, 1737, 300,000 are said to have perished; and again in 893 in India, 180,000. The greatest disaster of modern times, next to the present one, was the Messina-Reggio quake of 1908, with a loss of 100,000 lives. The most stupendous shocks on record are the Assam quake in India, 1897, destructive over 150,000 square miles and distinctly felt over one and three-quarter millions of square miles; and the Kansu quake in China, December, 1920. The former was not notably destructive of life and property, but in the latter the estimates of deaths run from 40,000 to 180,000, although as it occurred in a remote region, from which news was weeks in emanating, it attracted little attention. In the Sonora quake of 1887, felt over Mexico, Arizona, and New Mexico, an uplift of 20 feet occurred all along the base of a whole mountain range, but the region disturbed was only thinly inhabited. The great Alaskan quake of 1899, in which vertical displacements of over 47 feet occurred, passed almost without notice for some time.

More famous are the Neapolitan quake of 1857, the extensive study of which by Robert Mallet was the first great scientific contribution to what is now the science of seismology; the Lisbon quake and sea-wave of 1755, in which 40,000 perished; and the Avezzano shock of 1915, in Italy, in which the ratio of deaths to population was the highest ever recorded, 97 per cent of the people of Capelle having been killed. Chile is also noted for some disastrous quakes, the latest having been in November, 1922.

A series of tremendous shocks rocked nearly the whole of the then settled portion of the United States for many months in 1811-13. The topographic effects of this New Madrid earthquake, as it has come to be called, are still plainly visible in the Mississippi valley, and aftershocks are still continuing. The Charleston, S. C., quake of 1886 was relatively mild, but affected a very large area; the San Francisco earthquake and fire of 1906 is notable for the great property damage, but the deaths were very few.

The entire Fall Line of the Atlantic seaboard is a potential seat of earthquakes.



Active and recently active volcanoes of the world. The active volcanoes are shown as dots, while the recently extinct volcanoes are shown as crosses

Earthquake regions of the Eastern Hemisphere, shown in black

Prediction of Earthquakes

Possibly we shall some day be able to keep a record of the elastic vibrations of the earth's crust along danger lines, and thereby forecast a shock as we now do the coming storm. But that ability, if it come at all, must await patient investigations over many years in the future.

Geodetic surveys in California have indicated an apparent creep of the crust, relative to the Sierra Nevadas, in certain regions of about three feet in ten years. Prof. A. C. Lawson, of the University of California, considers this slow displacement to be a strain creep which accumulates until relief is effected by a sudden slip or a rupture, and he believes that it may some day be possible to predict about when the strains that are indicated by these movements will be released and cause a quake. Similar general indications may sometimes be obtained

On the basis of the number of quakes in the years immediately preceding, Omori in 1922 forecast the occurrence of severe shocks in Japan within six years. Similar general indications may some times be obtained from a study of the migration of epicenters in successive quakes along the seismic belts. A great quake relieves the stress in its neighborhood, and when next the stress finds relief it is likely to be at a more or less distant point along the belt. This is illustrated by the series of shocks along the west coast of the American continent from 1899 to 1912, as follows: Alaska, Sept. 4 and 11, 1899, and Oct. 9, 1900; Mexico, Guatemala, and other parts of Central America, Jan. 20, 1900, and April 19 and Sept. 23, 1902; Panama, Colombia, and Ecuador, Jan. 31, 1906; California, April 18, 1906; Valparaiso, Chile, Aug. 17, 1906; Mexico, April 15, 1907 and Nov. 19, 1912.

The most effective means of minimizing the danger from earthquakes is through exhaustive investigation of the location and activity of faults, and the study of the effects of earth shocks on buildings and structures, together with the creation of an enlightened public opinion by the wide dissemination of scientific information. The element of danger will not then be grossly exaggerated by ignorance and negligence.

Except where sea-waves and fire accompany the shocks, the loss of life is largely due to the shaking down of poorly constructed buildings. This can be prevented by a knowledge of proper materials and suitable types of construction. Only in Japan, however, has such knowledge been extensively applied. The native houses there are built to allow for earth tremors, being

(Continued on page 370)

Our Abrams Investigation—II

A Test to Determine the Accuracy of the Electronic Reactions Diagnosis

As reported by Austin C. Lescarboura

Managing Editor, SCIENTIFIC AMERICAN; Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

OUR FIRST test of the electronic reactions method of diagnosis took place on Saturday, September 15, in the laboratory of an Abrams practitioner in New York City. At the invitation of this practitioner, whom we shall refer to as Dr. X in the report which follows, we brought to his laboratory a number of vials containing pure germ cultures for the purpose of determining the accuracy and dispatch with which he could identify their contents. This seemed a simple yet convincing test, so we all agreed.

The laboratory, in this instance, is located on the ground floor of a typical high-grade apartment house in one of New York's exclusive neighborhoods. It is here that Dr. X carries on his diagnostic work, while in other rooms of the apartment he has a vast array of electrical and mechanical and luminous devices for the treatment of patients. The laboratory proper is by no means bare of apparatus; indeed, it fairly bristles with various devices and wires and lights. It might well be taken for an electrical or physical laboratory, rather than a doctor's consultation office. First of all, there are large metal plates on the linoleum floor; then there are numerous bare and insulated wires about the room; also, there are colored lights to one side, which, we are told, have to do with a chromatic method of diagnosis, which does not concern us in our present investigation; finally, there are several pieces of apparatus on the conventional white-topped table, which, at first glance, resemble nothing so much as electrical measuring instruments or, better still, radio equipment.

But in spite of all this equipment the main element in the electronic reactions method of diagnosis is the human reagent. Dr. Albert Abrams of San Francisco, the founder of this new medical cult which has attracted nation-wide attention, discovered a decade or so ago that the human body and blood had certain radio-active properties. Based on these early discoveries, Dr. Abrams has worked out a method of diagnosis whereby a healthy human being is connected in a so-called electronic circuit with a sample of blood to be tested, and the indicative reactions are obtained from the human being, known as the "reagent," at the hands of the skilled Abrams diagnostician. The reactions are generally detected by percussing certain portions of the reagent's body—the abdomen is the area usually selected, although for specific diagnosis other areas are used. Percussing is accomplished by passing the extended and rigid palm of the left hand over the abdomen of the reagent, and tapping the middle finger of the left hand with the middle finger of the right hand. The right-hand finger is provided with an ordinary celluloid thimble filled with beeswax and small shot, so as to obtain better thumping of the left hand. Normally, the percussing of the abdomen produces a characteristic hollow sound over an area which persists upward to a line on a level with the lower ribs. When the extended hand passes above this line, there is a decided change in the sound produced by percussing. The hollow sound now becomes a dull thud. The normal line of dullness having been determined, the reagent is marked with a black crayon to indicate the normal line.

So much for the normal reactions. When, however, the reagent is connected with the electronic circuit and a sample of blood or other representative matter from a patient, and when the electronic circuit is adjusted for various "rates" of vibration by means of a bank of switches, the area of dullness either remains at the normal line or drops down some two inches.

Let us go through a typical diagnosis, so as to make the workings of this method sufficiently clear to go ahead with the business of our first test. To begin with, the sample of blood or other matter is wiped, so to speak, with an ordinary horseshoe magnet, so as to eliminate extraneous electronic impressions. It is logical to assume that any sample, in the course of ordinary handling, must pick up its due share of these electronic impressions which we are given to understand permeate everything and everywhere. But why the electronic values of the patient, with all their delicate shadings and varying degrees of strength which go to make the diagnosis so critical as compared with orthodox medical practice, are not also wiped out or at least seriously impaired as the result of the magnetic wiping, we do not profess to know. We are still woefully ignorant on this point.

At any rate, the extraneous electronic impressions are wiped out and the sample is placed in the so-called dynamizer, which has also been wiped with the hard-working horseshoe magnet in order to wipe out electronic impressions that may have stayed behind from previous samples. The dynamizer appears to be little more than a neat, round container, at the bottom of which are two electrodes whose ends are separated by a small air gap. These two electrodes are generally connected together, and the single lead then goes to an amplifying device and to the array of other instruments. The dynamizer is provided with a close-fitting cap the under side of which has a metal plate connected with the other apparatus, consisting of multi-contact switches.

So far, so good. The reagent, stripped from just below the waist, up, takes his place in front of the diagnostician, standing on a pair of grounded zinc plates. The diagnostician is ready to begin work. He determines the normal line of dullness, puts a mark on the reagent's abdomen, and adjusts the little switches of the diagnostic machine for the first "rate" of vibration, which is 55, designed to permit only acquired syphilis electrons, or whatever they may be, to filter through to the reagent.

The diagnostician now percusses, and notes if the area of dullness has dropped down below normal. If it has not, the patient is "clear" on that score. If it has, then he manipulates a second bank of switches in order to obtain a quantitative reading. The second bank, like the first, is arranged with switch points in suitable multiples representing ohms or resistance introduced into the electronic circuit. The diagnostician adjusts the switches of the second bank until the area of dullness in the reagent has receded back to normal, indicating that sufficient resistance has been introduced to choke off the flow of the electrons of that given "rate."

Thus the diagnostician obtains not only a "rate," which in this case is 55, which, according to the Abrams chart of "rates," represents acquired syphilis, but also a quantitative reading in ohms, such as 3 ohms, 6 ohms, 15 ohms, and so on. The "ohms," of course, represent the degree of the ailment or affliction. We are told that the ohmage does not run uniform for different rates. Thus in tuberculosis 3 ohms is sufficiently serious to require treatment, while in malaria one can live quite comfortably with 17 ohms—the writer of these lines has been carrying 17 ohms of malaria—not to mention a nice array of other things with terrifying names and liberal ohmages—about for a long while back, without even suspecting the fact, until he was confronted with his electronic reactions diagnosis.

From "rate 55," the diagnostician goes to "rate 57," which represents congenital syphilis. If the reagent reacts to that rate, then the second bank of switches is manipulated to restore the normal line of dullness, and a reading in ohms is taken for congenital syphilis. And so the diagnostician goes down through a long list of "rates" which stand for as many ailments and diseases and afflictions. There is a set routine, of course, such as acquired syphilis, congenital syphilis, tuberculosis, gonorrhea, streptoccocus, colon septecaemia, typhoid, malaria, influenza, and so on. Incidentally, we might mention in passing that lucky is the person who escapes without a trace or more of congenital syphilis in an electronic reactions diagnosis. Hence there need be no hard feelings: we're all pretty much alike, electronically speaking.

The result of an electronic reactions diagnosis is a list of "rates," their corresponding medical terms, and their extent in ohms. Following such a diagnosis, the patient may be treated, if he so desires, and "cleared" of his various troubles. Some "rates" clear rapidly, while others require some length of time. When all the "rates" of a patient fail to give a reaction through the reagent, then that patient is considered cleared, or cured.

This method has to do with a diagnosis by proxy, so to say, in that the patient need not be present. There is no other feature of the Abrams teachings that is more spectacular—or more unbelievable. Here we have a means of diagnosing a given case at a distance without the presence of the patient; indeed, someone has promised to diagnose Egyptian mummies in order to determine the diseases which prevailed in the distant past! Skilled Abrams practitioners will assure you that they can take a specimen of your handwriting and not only tell you all about your medical history—past, present and future—but also your racial strains, religion and other choice bits of private information.

If the patient prefers, he can be examined directly, in which case he takes the place of the reagent and no sample of blood need be placed in the dynamizer.

In the examination of the writer, he served as his own reagent and had his abdomen and other parts of the body percussed to determine the various "rates" and ohmages. Aside from percussing, there are other methods of detecting the reactions, such as the attraction and repulsion and sticking of electrified glass rods passed over the reagent's body, as well as the deflection of pith balls such as are used in the physics classroom. In an early issue we shall have more to say about the apparatus or the mechanical side of this interesting subject.

Coming back to Dr. X and his laboratory, we start in with the reagent, whom we shall call "George" for short. George is a handsome lad of about 16 years of age. He has a remarkable physique, which was all the more in evidence when the editorial "we" disrobed sufficiently to serve as the reagent in a previous informal test. On the day of our present test George appeared to be in the pink of condition. Dr. X asked George if he had taken his usual quota of hot water, and upon receiving a negative reply he ordered George to do so. Then George did a few calisthenics—swinging his arms, working his legs, breathing deeply—just like a ring warrior getting ready for action.

Being curious as regards the mechanical side of this test, we studied the wiring of the plates which rested on the linoleum floor covering. They did not appear to be connected at first glance, and this aroused our suspicions. One of the grounding wires was traced to a water-pipe, which happened to be coated with paint. Here, we thought, was a weak point; but further examination disclosed additional grounding wires running to steam pipes and making good "grounds." At any rate, we were entirely disarmed in this direction when George

RESULTS OF THE ELECTRONIC REACTIONS DIAGNOSIS

The pure germ cultures used in this diagnostic test were as follows: Tube No. 1—Typhoid. No. 2—Pneumococcus. No. 3—Colon Septecaemia. No. 4—Tetanus. No. 5—Tuberculosis. No. 6—Diphtheria. The tubes were handed to the electronic reactions diagnostician with labels carrying the corresponding numbers, and the findings in ohms are given below:

	No. 1	*No. 2*	*No. 3*	*No. 4*	*No. 5*	*No. 6*
Acquired Syphilis	26	..	66	..	..	..
Congenital Syphilis	146	49	27	..	+	148
Tuberculosis	7	6	7	+	+	3
Gonorrheal Infection	38	39	16	..	+	200+
Streptococcus (Pneumococcus)	153	..	49	..	+	87
Malaria	59	17	17	39	+	23
Typhoid	..	..	..	..	..	..
Influenza	210+	36	46	22	+	..
Colon Septecaemia	..	53	9	22	+	63
Diphtheria	Not tested.			3	Not tested.	
Tetanus	Not tested.			..	Not tested.	

proceeded to test the plates by means of a standard electric light connected to one side of the current supply and to a free lead, the latter being played on the zinc plates and producing sparks as the lamp blazed up. This satisfied us that the plates were really grounded, although seemingly George went about his work quite unaware of our suspicions and purely as a matter of routine. As a bit of stage effect, however, it was excellent, to say the least. Even our technical mind, well versed in electrical practice, was momentarily impressed with the logic of the thing.

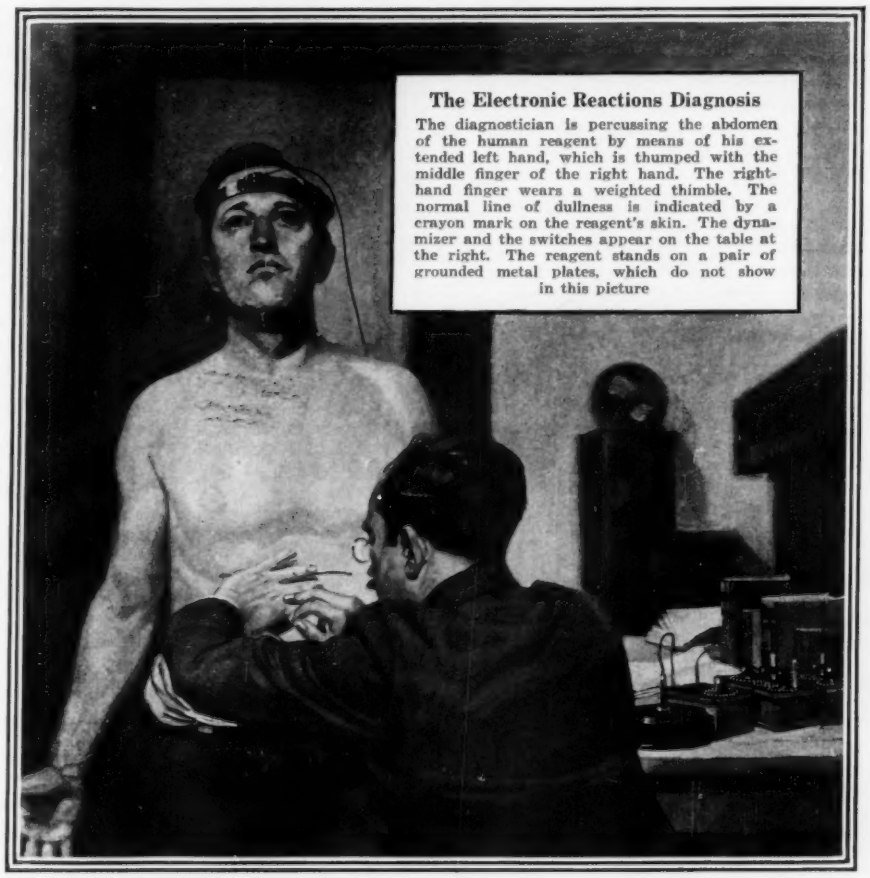
By now our committee was mobilized. For this test there were present an engineer, a bacteriologist of the Bureau of Laboratories, Department of Health, City of New York, and two members of the editorial staff of the SCIENTIFIC AMERICAN.

For the first half hour Dr. X and his assistant, a young lady whom we shall call Dr. Y, engaged with us in an exceptionally interesting conversation. The identity of the bacteriologist was not disclosed at this time. Dr. X told us of his interesting work as well as some of his extraordinary cases, the most startling of which was his recent treatment of a notorious character in New York medical circles known as "Typhoid Mary." This poor creature is a carrier of typhoid and has given New York no end of trouble. Dr. X told us how the health authorities, at his invitation, had sent the said "Typhoid Mary" to him for a test treatment. Despite the serious nature of "Typhoid Mary's" malady, not to forget several other serious ailments which the electronic reactions diagnosis disclosed, said "Typhoid Mary" was turned out in jig time, "cleared" of her ailments. This, obviously, was for us an astounding announcement—but only so until our bacteriologist spoke up, disclosing her identity and bringing forth the fact that she was quite familiar with this case. She assured Dr. X that if "Typhoid Mary" had been "cleared," she had not remained so. Parenthetically, we may mention in passing that we now have in hand the official record of her case, which shows that the claims of Dr. X were not founded on fact.

During the discussion between Dr. X and our bacteriologist, the latter brought out the point that a typhoid case runs in cycles, with a return to negative every so often. Could Dr. X have turned out "Typhoid Mary" at the low point in the typhoid cycle? We do not know.

But to go on with our main business after the preliminaries which reminded us in no little degree of a psychic seance—this chatting about the marvelous things that are being done regularly as contrasted with the simple business in hand—the test proper got under way. George took off his remaining upper garments and bared his husky chest and abdomen. Dr. X turned about in his chair, with his back toward us, facing George, who stood on two ground plates. George put on the headgear and arm electrode. We were asked to ground ourselves, by taking hold of electrodes connected to ground wires. And then the first pure germ culture in its little vial carrying nothing more than a red-bordered label with a plain, handwritten numeral, was handed to the doctor. One of our number who sat in one corner was asked to hand over the horseshoe magnet, kept at a considerable distance from the reagent.

At this point we are compelled to mention a slight inconsistency. The magnet, we were told, must be kept at least eight feet away from the reagent in order not to interfere with the delicate reactions. On the other hand, Dr. X pointed out to us the latest discovery of Dr. Abrams, which takes the form of a horseshoe magnet suspended a few inches over the head of the reagent. The purpose of this magnet is to allow for a closer differentiation between "rates." Heretofore it has been difficult to split between "rates" with a clean-cut and positive reaction. Why one horseshoe magnet should interfere with the reactions at a distance of eight feet or less, and another magnet should prove advantageous at three inches distant, we do not know. Furthermore, knowing how localized is the magnetic force of a small horseshoe magnet, we are struck with the extreme sensitiveness as well as inconsistency of the electronic reactions.



The Electronic Reactions Diagnosis

The diagnostician is percussing the abdomen of the human reagent by means of his extended left hand, which is thumped with the middle finger of the right hand. The right-hand finger wears a weighted thimble. The normal line of dullness is indicated by a crayon mark on the reagent's skin. The dynamizer and the switches appear on the table at the right. The reagent stands on a pair of grounded metal plates, which do not show in this picture

You have already learned from what has gone before that the electronic reactions practitioner goes from one "rate" to another "rate" in making his diagnosis. And in the event that the disease to be discovered is not included in his usual repertoire, he must needs continue his hunt after the manner of a search for the proverbial needle in the haystack. So, in order to save time and effort, Dr. X suggested that we give him a general idea of what the cultures included. This was fair enough. We did, cutting down the odds against the doctor.

The lights were dimmed—electronic reactions must be carried out in a dimmed atmosphere, so as to have a minimum of light energy interfering with the delicate processes involved. Dr. X began his search, percussing as he went from one "rate" to another. He announced his various findings from time to time. The first tube turned out to be gonorrhea, according to the electronic reactions, but not according to our records. That was fair enough. One specific answer for each riddle is the accepted procedure.

Then followed tube No. 2, for which the reactions disclosed congenital syphilis—true to Abrams form; tuberculosis, colon septecaemia, streptococcus, malaria, flu—well, that is as far as we went with that tube. Other "rates" would perhaps have given additional reactions, but we had ample. Needless to say, we were keenly disappointed with such findings. One specific answer should be sufficient. Here was a veritable broadside, not necessarily aimed to hit something through mere chance, but certainly open to such suspicion.

At this point Dr. X began to display some concern over the results of our test. Frankly, he agreed with us that pure germ cultures should be readily differentiated by means of his diagnosis, and that there should be but one answer for each tube. The purity of the germ cultures was questioned, and their origin was clearly stated in refutation. Some of the tubes contained 24-hour broth cultures, which had been transplanted from the pure stock of the Research Laboratories of the Department of Health, while others had been prepared by scraping the growth off slants of solid medium and emulsifying in sterile broth. About three cubic centimeters of the culture was pipetted into a serum tube, which was then stoppered with a rubber stopper and sealed with paraffin. Small labels, with a narrow red border and bearing the number of the culture, written by hand in blue ink, were pasted on the appropriate tube for identification purposes. Dr. X signified anxiety over the reagent. It appears that George, robust as he is, becomes exhausted in an electronic reactions sense. George was asked to "short" himself, which he did by pointing his hands toward his side. Normally, his hands are held down at his side, with palms facing forward and outward. George proved to be in the pink of electronic condition, for he brought his area of dullness right back to normal, even with conditions set for a strong reaction.

Then followed a talk about the super-sensitivity of the electronic reactions. Dr. X brought out the point that the electronic reactions are far more delicate than anything now in the hands of the bacteriologist, including the ultra-microscope. Pure germ cultures may mean just that to the orthodox doctor and bacteriologist; but to the Abrams diagnostician there is evidently no such thing as a pure germ culture. It was pointed out to us that the patient, from whom the germs were originally taken to be isolated and artificially propagated in the laboratory, was by no means an angel, and therefore had many of the ailments which afflict ordinary mortals. And now these ailments—or at least their electronic values—are carried right along with what is supposed to be an isolated culture. Further, these electronic values grow in power with age—perhaps one ohm a year would be about right, although this phase has never been looked into by the Abrams investigators, so we were told. Hence such a test as we endeavored to make was hardly fair, so Dr. X assured us.

A third tube was tested. Acquired syphilis, congenital syphilis, tuberculosis (slightest trace), gonorrhea, colon septecaemia, malaria and flu, but no streptococcus, was the verdict. Another broadside!

Well, it was evident by now that the electronic reactions were not proving their case. So the writer suggested that, inasmuch as we were dealing with pure germ cultures, surely these cultures should be preponderant in one "rate," as compared with the other "rates" which were due to traces of by-gone associations.

Dr. X thought this idea capital, and we began to test the pure germ cultures on the basis of ohms instead of the plain qualitative analysis as heretofore. The results are indicated in the accompanying table, which presents a ready means of comparing the electronic reactions diagnosis with the actual contents of the pure germ culture vials. A study of this table will immediately disclose that here again the electronic reactions did not meet with success. Instead of obtaining one preponderant ohmage for each tube, which would indicate the pure germ culture content, Dr. X obtained numerous high readings, so that the identity of each tube failed to be made out. Broadside upon broadside!

By now, things were not happy with the doctor. He fully realized that simple as our test was, it could not be successfully met. So he sought some reason for his flat failure. He asked to look at one of the pure germ culture vials. Looking at it in full light, presumably for the first time, he discovered the red edge on the label, as well as the blue handwriting.

Right then and there Dr. X found the reason for his unsuccessful diagnosis. He explained to us that red is fatal to the accuracy of the electronic reactions! The presence of that bit of red on each label was sufficient to upset the reactions completely. And by way of bringing out his statement, he told us that several days previous he had been working one entire morning with George, and had been obtaining very unsatisfactory results. Finally, toward the end of that morning's session, he asked George if he had anything about his pockets. A search disclosed a bit of red cardboard—the seat check of a theatre ticket!

Furthermore, there was handwriting on our labels. No doubt the electronic emissions from the writer of those labels were being carried along in the diagnosis. If so, the writer of those labels must have been in a terrible state of health—and mind, so we reflected at the time. Again, the labels were of the gummed variety, and might have been licked, continued Dr. X. Here our bacteriologist spoke up rather indignantly, and said that one of the first things a bacteriologist is taught is not to lick labels. A rather unhealthy practice, it would be, with so many choice bacteria about!

Well, this matter of labels had to be taken care of if our test was to proceed. So a member of our committee went into the doctor's office and wrote a set of plain

(Continued on page 370)

Within the Atom

At the Very Foundation of Matter with the Electrons and Protons

By Sir Oliver Lodge

FORTUNATE indeed is the SCIENTIFIC AMERICAN in being able to present to its readers an interesting, popular article on the structure of the atom, written by the eminent British scientist, Sir Oliver Lodge. By common consent the author of this exposition stands as the dean of all living physicists. His lifelong researches in an attempt to ascertain a knowledge of the ultimate nature of matter, energy and life, the three elements that are commonly believed to make up our Universe, have been crowned, mainly, with success. We cannot "see" the atom, much less the electron; but the physicist has been able to devise instruments that nevertheless enable us to appreciate them with our weak senses, of which these instruments become, as it were, powerful extensions.

WE HAVE gradually learnt that electricity exists in two forms, the negative form, which is called an electron, and the positive form, which is now beginning to be called a proton. There is no other kind of electricity so far as we know. The material universe seems to be built of these two elements. Both the electron and the proton are exceedingly small, very much smaller than an atom of matter. Both probably have weight, though one is much heavier than the other. The proton weighs as much as 1830 electrons. But it is not appreciably bigger, and some even think that it may be smaller than an electron. The fact is, we do not know very much about it, except that it is the unit of positive electricity, just as an electron is the unit of negative electricity. Whether the proton is an ultimate unit, or whether it can be resolved into a close-packed assemblage of simpler ingredients, which would account for its remarkable weight or massiveness, remains for future discovery. It may have a complicated structure for all we know: but at present it seems to us one and indivisible. So does the electron.

Parenthetically, we may say that both are hypothetically supposed to be probably built up in an unknown way out of the ether of space; so that they need not be foreign bodies in the ether, but a specifically organized portion of it. But all this is at present hypothetical and need not be emphasized. Suffice it for present purposes to say that both electron and proton certainly exist; and almost as certainly that they constitute the apparently indivisible elements of which all matter is composed.

They are, however, both closely related to the ether somehow, for they attract and repel each other. That is to say, there is a strong mutual force urging electrons and protons together, and at the same time keeping apart the units of the same kind; and this force, whether of attraction or repulsion, must necessarily be exerted through and by means of the intervening ether. Furthermore, we know that when either is in motion it is surrounded by a magnetic field, which magnetic field consists of some modification in the ether, and extends a considerable distance round the moving nucleus or kernel. These facts are commonly expressed by saying that a moving charge has two fields of force; one, radiating from it in all directions, is called its electric field; while the other, which surrounds its line of motion in rings—opening out more and more of them and crowding them closer together as the motion increases in speed—is called its magnetic field. It is this last which confers upon each unit its fundamental property of inertia; that is, its power of persisting in motion until it is disturbed—checked, hastened or deflected—by some external force.

The size of these electric units is now known with fair accuracy. But about their shape nothing is known. It is natural to think of them as spheres, but there is no evidence for that shape and no reason can be given why they should have that shape. The spherical shape is characteristic of large masses of matter, such as suns and planets, and for good reason. A large enough body must be spherical; otherwise it is unstable. A great mass of matter of irregular shape, or even of regular shape, like a cube or a cylinder or an elongated oval, could not remain in that condition. Its protruding portions would be pulled down and merged in the rest by gravitative attraction. But no such force acts effectively on a small body. It is too insignificant in amount to be effective. Accordingly, the shape of a small body has to be ascertained by observation. It may be like a marble; but it might equally well be like a ring, or a sixpence, or a corkscrew. Or again it might be shaped like a feather, a seed, or a tadpole. We assume that every proton is like every other, and that all electrons are alike, too. But we do not know even that for certain. Meanwhile, it is natural and simple to think of them as little spheres, always bearing in mind that there is no evidence for that assumption, and no evidence against it.

We know so much about these units now that it is well to remember from time to time the points about which we are still ignorant. We know approximately their bulk and their mass, or what is commonly called weight. But of their shape, structure and constitution we are ignorant. We know that a proton weighs just about the same as one atom of hydrogen, but that it is in bulk a million million times smaller. We know that an electron is comparable in size to a proton, but is 1830 times lighter or less massive. This 1830 is an experimental number and does not pretend to be quite accurate. It may turn out to be as small as 1820, or as large as 1860. But the best measurements lie between these two extremes, and 1835 is a very reasonable value, according to our present information. This may seem unimportant, but I mention it as showing how precise our knowledge about these things is gradually becoming.

In the same spirit I can say that the diameter of an electron has been measured as 37½ times the hundred-million-millionth of a centimeter. And that the weight of an atom of hydrogen, with which we have above compared it, is 1.66 times the weight of a milligram divided by one followed by twenty-one 0's. That is to say, that an atom of hydrogen weighs a million million million times less than a minute visible speck, such as a granule of lycopodium, which is about as small as can be weighed on a very delicate chemical balance.

A special fact may here be mentioned, as testifying to the correctness of our knowledge as far as it goes. An electron has a certain exceedingly small mass or weight, but when it is moving very fast—much faster than anything we ordinarily know of—this mass or weight ought, on electrical principles, to increase, by an amount which can be predicted. Such an increase was, in fact, predicted, and its amount calculated, at various high speeds short of the speed of light. Experiment subsequently became possible, with the particles shot off by radioactive substances; and when the mass or weight of these violently flying particles was measured, and compared with the theory relating to the increase expected, the calculated and observed values were found to agree exactly. These scientific predictions, and their confirmations, ought to be better known and understood by the world at large.

The increase of mass with speed is consistent with Relativity doctrines; but it was fully known before that. Only, now we feel pretty confident that the same thing applies to all matter; and that matter is therefore electrically constituted.

That these minute corpuscles can build up gigantic bodies such as the earth, the planets, the sun and the stars is astonishing—like most other things in the universe when we dive down into them. But yet it seems an undoubted fact, for which the evidence is exceedingly strong, so strong as to be practically conclusive. It has long been known and admitted that these great bodies are built up of atoms, and now we have learnt that the atoms are themselves built up of electrons and protons. And we have begun to learn what is the structure of an atom, that is to say, how it is built up out of its constituent elements—the opposite units of electric charge. We are now, however, entering on a region where some debate is permissible and some differences of enlightened opinion may exist. But the hypothesis which holds the field, and the one on which Rutherford and Bohr and others are working, is that the atom is built up on the general pattern of a solar system. That is to say, that it consists of bodies arranged like the sun and planets, on a very minute scale. First of all we find a group of protons in the center, half of them presumably welded together by a compact and interleaved assemblage of electrons, which are also able to hold on the other half of the protons as part of the compact group. This central group represents the sun; and outside it, and at some distance from it, we find a regular series of electrons revolving round it, either singly or in rings, like the planets; or possibly in some cases, though less likely, like the Ring of Saturn.

Furthermore, it has been found possible to count the outstanding or unneutralized protons and electrons in atoms of different kinds.

By "atoms of different kinds" I mean the chemical elements, iron, lead, zinc, carbon, oxygen, hydrogen, sulfur, gold and radium and all the eighty-three other elements of which the world is composed. There seems no doubt about this counting, though it is a remarkable achievement. It is the result of work done by several living men, such as Rutherford and Barkla, and especially by young Moseley, who was killed by a Turkish bullet shot through his brain at Gallipoli—a remarkable testimony to the efficacy of war in settling human affairs.

The number of unneutralized protons at the center, and the number of planetary or revolving electrons in any given atom in its normal state, must be the same. Many or few, there must be the same number of each; otherwise the atom would be electrically charged, and would not be in its normal condition. One electron too many would yield a negatively charged atom; two electrons too many would be doubly charged; and a few atoms might be even triply or quadruply charged. But such charging must be considered exceptional and not likely to be permanent, for these additional electrons would be hanging on in the teeth of some repulsion and would soon be likely to escape.

On the other hand, a deficiency of one or two electrons in an atom would mean that it was positively charged, and that, too, would be an unstable and exceptional condition. For the electrical force exerted by such an atom would be very great and would soon be able to collect stray electrons and thereby restore the balance to equilibrium. When the charge of an atom is unbalanced or not neutralized the atom is readily guided and propelled and, as an easy traveler, is called an "ion."

EVERYONE is familiar, at least with the words "electron", "proton" and "nucleus", but many have experienced some difficulty in getting an unconfused, clean-cut conception of the beliefs at present held by the majority of scientists concerning the various inter-relations of these components of the atom. In the accompanying article the distinguished author demonstrates a facility which, on the part of the higher scientist, is rare—that of putting himself in the place of the more or less popular reader of science and making his phraseology and style plain, simple and free from the puzzling technicalities that, while A-B-C to himself, cannot with comfort be followed by the average reader.

It is not to be supposed that the protons and electrons here spoken of as contributing to the central positive charge and the equal peripheral negative charges are all the protons and electrons that exist in the atom; the nucleus may contain many more, and in fact usually does contain about double that number. Those of which we here speak are the most prominent, the most efficacious and, in fact, are those upon which the chemical properties of the element depend. The others, tight packed in the nucleus, contribute to the weight of the atom, but do not contribute to its chemical nor to its radiative properties. They are more like an inert mass of satisfied material upon which the other more active and demonstrative units are grafted. The compact central mass does not contribute to its electrical behavior, which is the most conspicuous phenomenon in an atom, whether it be regarded from the physical or chemical side; they con-

tribute only to its weight and inertia and mechanical properties generally.

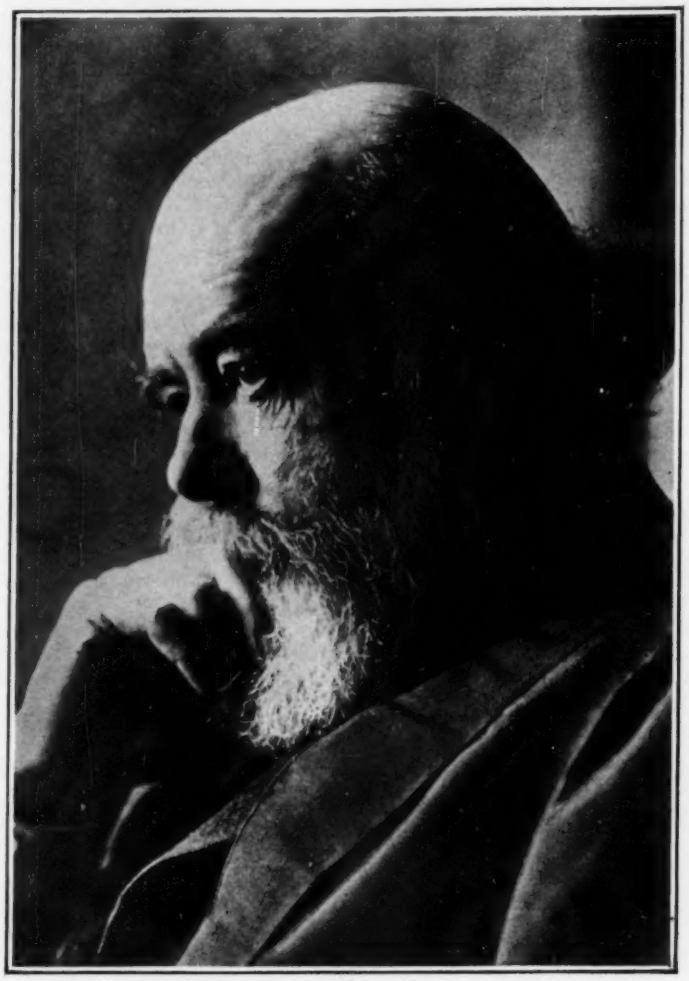
Consequently, the inert part of the central mass is often ignored, and seemed to be of minor importance until some means was found for breaking it up. Attention was and is concentrated chiefly upon the outlying negative electrons and upon the corresponding number of protons which by their electrical attraction hold them together into a sort of solar system. These are what have been counted, and these are what are chiefly important to our present knowledge. But the others do not escape detection, and it is easy to count them, too—in fact, quite easy, for they are responsible for the atomic weight and are at once determined by the weight of the atom. Given that an atom of hydrogen contains one proton, and weighs one, then an atom with atomic weight 16 must contain 16 protons. But not all these are active; only 8 of them exhibit electrical forces and hold 8 electrons in orbital movement. The other 8 constitute the rest of the nucleus and represent its electrically neutral portion.

So also with an element of atomic weight say 31. Sixteen of them are inert and 15 of them are electrically active. The active number are what determine its chemical and spectral behavior, and it is known as the atomic number of the element. Roughly, it is usually about half the total number, sometimes exactly half, though in all cases rather smaller than half when not exact.

Anyone can tell how many protons altogether there are in an atom: Simply the number expressing its atomic weight on the scale in which oxygen = 16. The interesting thing is how many of these are chemically or electrically active, and this is given by what is called the atomic number. Of this number there can be no fraction, and it proceeds regularly through the different elements from 1 to 92. Nearly all these 92 elements are known—there are only three or four gaps—and any day the few outstanding gaps may be filled by the active and enlightened investigators of the present day.

If we now ask how many electrically active protons, and how many electrically active electrons, go to make an atom of sodium, the answer is forthcoming. The number is 11 of each. If we ask the same question about chlorine, the number is 17 of each. If we ask it about carbon, the answer is that six of each kind of electric charge constitute the effective part of the atom of carbon. If, however, we proceed to some of the heavier elements and ask the question about lead, the answer is the suprising number of 82 of each kind. If we inquire into the constitution of radium we find 88 of each kind; 88 active protons along with 137 of the inert or satisfied variety exist at the center, and 88 planetary electrons, either revolving or else grouped in some pattern, are attendant round the central nucleus or sun. The heaviest known element is uranium, and for that the number is 92. No element with a greater number than that is at present known. Possibly any greater number would be too unstable to exist for any length of time, so that it would be extremely rare. Even uranium is not quite stable: and if we were to watch an atom of uranium for a sufficient length of time—which would be a very tedious business, for we might have to wait a thousand years—we should see (that is, mentally "see," for, of course, an atom is hopelessly invisible) a group of four protons violently escaping; and we should see electrons escaping too, two packed up with the proton group and two thrown off separately, showing that of the four protons two came from the inert portion of the nucleus and two from the electrically active portion, so that the projectile retains a double, not a quadruple, electric charge. The number remaining of the active variety of each would thereby be reduced to 90, which would mean that it was no longer uranium, but another element called uranium X. And this also would explode or fire off a particle in time, so that the number would then be reduced to 88, when the main or residual substance would be radium. Then it might go on with rather increased activity, though still only very occasionally as far as each atom was concerned, until the number got down to 82, with two well marked intermediate stages, one of them called by Madame Curie polonium. The element with 82 active pairs would be fairly or perhaps quite stable and would be indistinguishable from lead. If the number ever got down to 80 it would be mercury. And at 79 (though that is not in the true line of descent) it would be gold.

So much for the heavier, unstable end. But what about the lighter elements? Carbon, for instance, has only six pairs; oxygen has eight, nitrogen seven, lithium has only three. Helium, that comparatively rare, inert gas, found by Sir William Ramsay to be given off by certain minerals and by the hot springs at Bath and other places (given off also during the disintegration of radium), an element first discovered spectroscopically by Norman Lockyer in the sun and hence called helium, or "helion," as we now see that it ought to be called, has only two. But the first known of the inert gases, the one discovered by Lord Rayleigh, viz., argon, has eighteen. The helion atom has the atomic weight 4. So it must contain four protons in all and, of course, also four electrons. Two of these seem more closely imbedded in the structure than the other two, but all of them are so tightly held that the atom has very little external field and accordingly is chemically inert—so inert that the atoms are unable physically to hold together by cohesion. Therefore it exists as a gas consisting of isolated atoms. The smallest jostle or provocation will separate such atoms from each other and, accordingly, it can be liquefied only at an exceedingly low temperature, very close to absolute zero. For at that low temperature the jostling practically ceases and the atoms are so nearly quiescent that the bonds of their feeble residual affinity are not broken.



Sir Oliver Lodge, Principal of the University of Birmingham and leader in research on the nature of the atom

The atom of helium is very like one of those projectiles flung off by a radioactive substance and called an alpha-particle; but whereas an atom of helium is electrically neutral, an alpha-particle is by no means neutral. It has a double positive charge and it needs two electrons to satisfy it. But these it soon picks up, and then it becomes the completely satisfied and inert atom of helion. The 4+2 have become 4+4.

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Is there any element that has only one constituent pair, one proton as the central nucleus and one revolving satellite, like an earth-moon system? Yes, the answer is definite and certain. The lightest known element is hydrogen, and hydrogen has only one of each. The hydrogen atom is constructed on the pattern of the earth and moon.

Thus there are exactly ninety-two elements and no more. One cannot imagine an element lighter than hydrogen, unless it is possible to split a proton and an electron into fractions. It is easy to imagine an element heavier than uranium, or any number of them. Hence, in that sense, there may be more than ninety-two; but not by interpolation; only by extension of the heavy end. And although such elements have been looked for—notably an inert gas with the atomic number 118, which might possibly have been expected—none of them has as yet been discovered. The evidence on the whole is against their probable or frequent existence. However, the possibility of building up still more complex and probably still more unstable elements, under special conditions of temperature and pressure, remains a subject for future discovery.

The building up process we have not learnt how to accomplish; nor have we ever observed it going on. The tumbling down or disintegration process we have observed; it constitutes the phenomenon called radioactivity. But even that we are unable to control. It goes on spontaneously or not at all. Nevertheless, it goes on with great violence. The atoms really do explode, as a cannon explodes, firing off a shot with great vehemence at a speed of several thousand miles a second.

And the nature of this shot has been analyzed. We might have expected it to be a proton. But, strangely enough, it is not. As stated above, it is a group of four protons, welded together by two electrons, all apparently jammed together into a compact mass, without any satellites or revolving charges. The projectile really is a projectile weighing four times as much as an atom of hydrogen. And, moreover, it is not in a permanently stable condition. It seems stable enough mechanically, but not electrically. It has four positive charges and only two negatives. Consequently it is electrically unbalanced. It has a double positive charge.

A projectile of that kind, moving at that tremendous speed, is quite a serious thing and can do a lot of work before it is stopped. If it hits a phosphorescent substance it emits a flash of light. If it strikes another atom it might do some damage.

But if an atom is like a solar system, we might well ask, "What is there to strike?" Will it not rather go through an atom? Certainly, that is what is to be expected, and that is what happens. Atoms are exceedingly porous, just as porous as a solar system, so that a projectile going through them is quite unlikely to hit anything. But every now and then it may, and sooner or later it must, on the doctrine of chances. It may go through ten thousand atoms without hitting anything. But if ten thousand projectiles were loosed through the solar system at such speed that gravitation had no appreciable effect, one of them at least might hit the sun, and then something would happen.

Sir Ernest Rutherford has tried the experiment with nitrogen. He has got one of the radioactive materials, offsprings of radium, to fire its projectiles through nitrogen gas. Thousands of them hit nothing or encounter only one of the electrons, which they may be able to sweep up and carry away without much disturbance, for an electron is such a light thing. But occasionally they may hit the nucleus. And the nucleus of nitrogen is fourteen times as heavy as hydrogen, while the projectile is four times as heavy. Hence the encounter is no trifle. The experiment is like firing a crowd of suns, each a quarter the weight of our sun, through the solar system. Many go through free and go on; some might sweep up and carry away one or other of the seven planets. But one by chance encounters the sun itself. There is a smash and the sun breaks up. The atom of nitrogen is disintegrated, not by spontaneous radioactivity and by its own energy, but as by the explosion of a shell or the impact of a violent projectile.

And what happens to it? Is it dispersed into its constituent protons, or do some of them hang together still? The answer can only be given by experiment. The answer found by Rutherford is something like this: that most of them hang together in groups, constituting three atoms of helion, while two odd ones are flung out with great speed—even greater than that of the projectile which drove them—so that we get violently ejected atoms of hydrogen.

It is as if the atom of nitrogen were really composed of three helion and two hydrogen atoms—as if it were a compound of those primary elements and that it was disintegrated or broken up into its constituents by the impact of an alpha-particle.

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Our Point of View

Navy Day

BECAUSE of the inevitable decline of interest in the Army and Navy which manifests itself at the close of a great war, the setting apart of one day of the year as Navy Day, on which the country is asked to give thoughtful attention to naval affairs, is altogether commendable.

Speaking in favor of the institution of Navy Day, and having in mind no doubt the pernicious propaganda which aims at the immediate abolition of all armaments, President Coolidge recently said: "Our country has undertaken, as its proper contribution to ameliorating the burdens of armament in the world, to place certain strict limits on our naval establishment. In view of these, it becomes desirable that the highest efficiency in men and material be maintained." To the same purpose, Acting Secretary Theodore Roosevelt reminds us that "behind the protection of the Navy our people are able to carry on their lives, develop their ideals and live in the righteous peace we so earnestly desire. It is the right arm of our State Department."

Of the misleading statements made by those who would emasculate, if not altogether destroy, our Navy none is more false and unjust than that which describes the Navy as a symbol of war and its officers and men as the advocates of war. As a matter of fact, from admiral down to enlisted man, there are no citizens who are more united in the earnest desire for peace. They know what war means. President Kelly of the Navy League is well within the truth when he states that no men are more truly pacific than our Army and Navy men—"our own brothers and sons, who realize more keenly than others the horrors of war, and seek only the strength that will maintain peace—the peace of honor and justice, which is the only peace America should ever tolerate."

When the history of the stupendous events of the war and the post-war period comes to be written, and they can be judged in their true proportion, we believe that the gathering around the table of the five leading naval powers at Washington to frame the Treaty of Limitation, will be recognized as perhaps the greatest single contribution of the United States to the permanent peace of mankind. That treaty has now been ratified by all the powers concerned, and they, with us, are at present engaged in breaking up the superfluous material of over-developed navies.

Let no one regret this destruction, for this superfluous armament was the child of suspicion, fear and international hatred. The fleets as reduced by the treaty are no more nor less than the international police of the high seas. It is the duty of the American people to maintain its present Navy, which is preeminently a preserver of the peace, at its highest possible level of efficiency, and give to it at all times loyal and patriotic support.

"ZR-1" Sails Over New York

OUR FIRST sight of "ZR-1" was from the observation platform of the Woolworth Tower, as she reached New York City exactly at the hour predicted. It was in mid-September, and a faint haze, suggestive of Indian Summer days to come later, softened the outlines of the city below. Precisely at 11.30, out of the air came the distant drone of the airship's motors, and lo! above the Statue of Liberty there became visible through the haze what looked for all the world like a gigantic silver bubble, which grew in size until the great ship swung to port and revealed the whole 680 feet of her truly beautiful form to view. With her six motors throttled down to half speed and the national flag snapping at her stern, she swept majestically by as she laid her course up the Hudson River.

Apart from the beauty of the spectacle (and a silver-tinted dirigible, when seen under such conditions, is an undeniable object of beauty) the most striking impression was that of the stability and perfect control of the vast ship; which, be it remembered, in spite of the light and fragile materials of its construction, weighs no less than thirty-seven American tons. Throughout her journeyings up and down the length of Manhattan island she traveled for the most part on a level keel. Occasionally, vertical and horizontal changes were made under an easy helm and very gradually. Evidently, in these early trials her commander is not going to subject "ZR-1" to the severe bending stresses, due to a sudden and extreme shift of the helm, which crumpled up the girders of "ZR-2" and brought about the fatal disaster at Hull, England.

During her last run, before heading for Philadelphia and home, she passed directly over the Woolworth Tower twice as far above our vantage point as we were above the street below. To stand on a man-made structure that soared 750 feet above the earth and watch that huge fabric, big in bulk as the tower itself, sweeping majestically across the heavens was a sensation indeed! Here were the dreams of the builders of Babel and of Dædalus himself come true!

The primary purpose for which the Navy has built this ship is to act as a scout for the Atlantic fleet—a work for which her great speed and large radius of action render her preeminently suited. Some day in the future we shall have a squadron of such ships to act as the farseeing eyes of our battleship fleet. Scouting abreast, in a line flung wide across the Atlantic and in radio touch with each other and with the commander-in-chief, they will render impossible any surprise attack upon our shores.

It is no empty boast to claim that "ZR-1" is the finest airship of the rigid, or of any other, type that has ever been built. For so she should be; since within her has been incorporated all the experience of the Germans, who originated the Zeppelin, and of the British, who carried on dirigible construction in the years succeeding the war and made a successful round voyage from England to America and back.

But over and above this, the new design has engaged the best talent of our very able corps of naval constructors. Not only have the stresses (far more complicated in a ship of the air than in a ship of the sea) been made the subject of exhaustive study, but every member that was built into the framework was first tested in the naval aircraft factory at Philadelphia. Finally, and greatest surety of all, the use of the ever-dangerous hydrogen has been abandoned and "ZR-1" is filled solely with non-explosive helium. Hence she is the first ship to be rendered immune to the flaming bullets of attacking airplanes.

Pandora's Chest Modernized

OUR FAMILIARITY with the wonders of radio broadcasting may not exactly breed contempt, but at least it takes away from the romance of the thing. As a fairy tale, radio broadcasting would fare quite well; indeed, the present-day receiving set in the home, bringing to the household the music and news and talks from the four corners of the globe, might well fill the rôle of the famed Pandora's chest with its never-ending flow of beautiful contents. As a reality, however, radio loses its romance as it gains in practicability and popularity. But, then, this is a practical age!

Pandora's chest—that is the keynote of radio development today. When radio first came into the household as the result of broadcasting, it had a distinct laboratory touch. There were numerous handles to adjust, storage batteries to recharge, dry batteries and connections to watch after and a maze of wires connecting the various scattered components. Frankly, as a living room furnishing the radio set was designed to upset the best of decorative schemes, and more than one fastidious housewife stood firm against such invasion and insisted that the radio set stay in some far-off corner of the house, there to be enjoyed but not seen.

But radio broadcasting has brought about a change in radio engineering and designing of apparatus. It soon dawned on radio engineers that the receiving apparatus, as used in the average household, is only the means and not the end. It is merely the medium for receiving the broadcasted programs; in truth, the average person would as soon do away with the receiving set and use a plain tin horn, if such a crudity would give the desired results. The popular demand has been for more and more simplicity combined with greater and still greater efficiency.

The answer to all this is now evident. Radio engineers have done remarkably well—almost unbelievably well. They have eliminated the troublesome storage battery; they have devised new types of vacuum tubes the filaments of which require a minimum of current, which can be supplied by ordinary dry cells; they have worked out simple circuits which reduce the controls to a minimum while giving excellent results; they have developed good loud-speakers, which do away with the necessity of head-phones; they have designed attractive cabinets which now contain every component of a radio set, including the batteries. The result is the compact, attractive cabinet which is invading the sacred premises known as the living room. The highest development of this kind is in the form of cabinets resembling phonographs, containing everything, including the loud-speaker horn.

So, at last, we have the modernized version of Pandora's chest. In the corner of our living room we have a small, attractive cabinet, blending in with the general scheme of things. We step up to the cabinet, turn a small knob to light the filaments of the concealed tubes, and another knob to search for stations. We hear a faint whistle. We move the knob more cautiously, dissolving the whistle into the strains of an orchestra. We move a second knob, which gradually intensifies the orchestra strains until the desired volume of sound is obtained from the loud-speaker horn. For quite a while we listen to the various selections of this orchestra, coming from the roof garden of a renowned hotel 30 miles away. At 10 o'clock we tune in for the ringside in a neighboring city, where a much-heralded bout is being staged between famous heavy-weights. We hear the fistic battle, blow by blow, as well as the gong, the cheers of the throng, the whistle of the timekeeper, and other noises that go with pugilistic activities. The battle is soon over, and we know the results several hours before the newspapers are available from the city. By now it is 11 o'clock; the local broadcasting stations have "signed off" for the night. Again we explore with the tuning handle—a whistle—and then a jazz band. Clear; loud; good. Then comes the announcer's voice. We learn that the jazz music is from a city half-way across the continent!

So Pandora's chest of fiction is now excelled by the Pandora's chest of fact. Once more, truth is stranger than fiction.

A Poorly Housed Business Institution

THERE is nothing adds to the success of a business institution more than proper housing. This is true of governmental business institutions as well as of private concerns. The United States Patent Office is one of the few offices in which the earnings are relatively large as compared to the expense, ranking in this respect with the Post-office Department, Customs Bureau, The Internal Revenue and similar income earning branches of our great Government. The Patent Office has a somewhat unique arrangement in that it runs what might be termed a large retail store, the stock of which is limited as to variety, but is almost unlimited as to quantity. This is the branch of the Patent Office that is devoted to the sale of soft patent copies of patents. Millions and millions of soft copies of patents are stored in the United States Patent Office for sale at a very considerable profit and the number handled each day would gladden the heart of a merchant prince. Owing to inadequate facilities these copies are spread all over the Patent Office Building. In hallways here, in corridors there, and in vault

Our Point of View

rooms extending out under the foot pavements of the city and in tier after tier rising so high as to necessitate ladders to reach the upper row. Many of them are on wooden shelves that increase the danger from fire and the spreading of the copies all over a large building necessitates the copy pullers traveling mile after mile each day in pulling the copies. A limited quantity of metal racks have been provided but these do not begin to supply the reasonable demand. The copies are so distributed that it is difficult to promptly secure a desired copy, and this in a large measure reduces the sale, as instead of ordering copies the person desiring them will take the trouble to inspect the records of the Patent Office to avoid delay. Much of this could be avoided by providing suitable metal racks for all the copies and also by providing for the arrangement of the copies in compact form and in close proximity so that the pulling of the copies will be greatly facilitated.

The rooms housing the various Examiner's divisions are all seriously crowded, thus interfering with the work and adding delays where the delay is now of great inconvenience to the public, and some divisions are housed in the corridors where they are partitioned off by file cases and subject to all the interruptions and disturbances incident to those traversing the corridors.

The copies of foreign patents issued since 1914 were greatly delayed in delivery by the War, and when finally delivered to the United States Patent Office were delivered in such bulk that space is not available for the proper classification, nor is the Patent Office force sufficient to permit the proper classification of these copies, so that searches among the foreign patents are necessarily incomplete and extremely unsatisfactory.

All of the foregoing could be avoided and the Patent Office be conveniently housed and well officered, if the recommendations in the Commissioner's report for the year ending December 31, 1923 had been carried out by Congress. As the Patent Office is really a business institution, serving the public and being well paid by the public for the service rendered, there appears nothing unreasonable in the desire and expectation that Congress will afford suitable facilities for the proper transaction of business which in itself is profitable to the Government.

The Navy's Contribution to Industry

THE present agitation in favor of the complete abolition of armaments and, therefore, of our splendid Navy, is unthinking, uninformed, and generally springs out of an abysmal ignorance of the subject. To be consistent, the advocates of complete disarmament should call also for the abolition of those police forces which enable city dwellers to work and sleep in security.

In a recent issue, we touched upon this subject, and laid special emphasis on the value of the Navy as a training school for our young men in habits of orderliness and discipline, and in respect for constitutional authority. We now draw attention to the fact, so generally overlooked or ignored, that the great merchant fleet which fetches and carries the products of industry is equally indebted to the Navy for the great technical improvements which have helped to raise it to its present standard of speed, comfort, reliability and high operating economy.

Take the fundamental question of ship propulsion. Less than 25 years ago the cumbersome reciprocating engine was in exclusive possession of the field, both as to freight and passenger ships; and it is largely to the ceaseless initiative and support of naval engineers, both here and abroad, that the world owes those successive improvements which have given to us, first, the direct connected-turbine, then the geared-turbine, and lately the steam-electric drive, which last has proved itself so satisfactory to our Navy that the latest battleships are equipped exclusively with this system. To the navies of the world, also, we are indebted for much experimental work in the development of the Diesel marine engine, which in economy of weight, space and consumption stands so far in the lead as to be in a class by itself.

But, although its work in developing improved means of propulsion is its greatest contribution, we must not forget that there are hundreds of other directions in which this great "laboratory of experimentation," as the Navy has justly been termed, has made generous contributions to industry. The electrically operated winches, pumps, ventilating fans, and various other auxiliaries which are now being introduced aboard merchant vessels, have been in use for over fifteen years in our Navy. Furthermore, the Navy was a pioneer in the use of super-heated steam; and the Merchant Marine is indebted to it for research work in developing alloys of various kinds for condenser tubes and other purposes; for its elaborate investigations of lubricating and fuel oils; and for its development on a large scale of electrical welding methods. The Navy's model basin at Washington, moreover, is responsible for improved models, not only of merchant ships but many of the notable steam and sailing yachts of the country. In this connection, it may be stated that the lines of not a few of the American cup defending yachts received their final determination as the result of trials in the Navy towing tank. When we come to navigation, we find that the Navy has rendered invaluable assistance. To its Hydrographic Bureau, we are indebted for extensive marine surveys, and for the superb charts, issued regularly by the Hydrographic Bureau. The ice patrol safeguards the passage of our great liners by locating and distributing by radio the position and course of those terrors of the seas, the icebergs. Many a good ship has been saved from disaster by the "radio compass" system, a Navy development by which ships as they approach the coast can obtain their exact locations, even when they are shut in by dense fogs and blinding snow storms. When a ship enters the harbor channel, she can maintain herself accurately within her narrow limits, keeping in electrical touch with a pilot cable laid on the bottom through the center of the channel. Only recently we illustrated in this journal the new Navy system of sounding by sound, the practical operation of which was recently proved when a Navy ship charted the ocean floor from America to Europe in a fraction of the time which would be necessary by the old method.

Nor must we forget that the Navy gave to the steel industry in America the greatest single impetus which it has ever received. Thirty years ago, when we began to build our first steel ships, we possessed no mills that could fabricate the heavy forgings needed for armor plate and guns. Such things could be obtained only abroad; but the Navy arranged with American manufacturers to install the necessary plant for this heavy work; and it was this far-sighted policy which started our heavy steel trade on an upward course, which, within a few years, had made us the premier steel manufacturing country in the world. So far from its being an economic waste, the Navy is at once the police force of the nation, a training school for its youth, a great laboratory for the development of new industrial processes, and one of the greatest exponents of the true "live and let live" patriotism.

Adirondack Forest Preserve Threatened

THE ATTEMPTED raid by private interests on the Adirondack Forest Preserve, by means of an amendment upon which the people of New York State will vote on November 6, is a matter which affects every State in the Union; for if the amendment should pass, it will suggest and encourage similar action by private interests against the forest reserves in other States of the Union.

The attack is being made under what is known as the Ferris amendment to section 7 of article VII of the State Constitution, in relation to the Forest Preserve. Section 7 reads as follows: "The lands of the State . . . constituting the Forest Preserve . . . shall for ever be kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed. . . . The Legislature may by general laws provide for the use of not exceeding three per centum of such lands for the construction and maintenance of reservoirs for municipal water supply, for the canals of the State, and to regulate the flow of streams. Such reservoirs shall be constructed, owned and controlled by the State."

Thus far the amendment follows the present constitution. It then proceeds to provide for private exploitation, by adding a clause which strikes at the fundamental principle of the present law. This reads as follows: "The Legislature may also provide by general laws for the use of such lands for the development of water power for the public benefit, and for the construction, maintenance and operation thereof of ponds, structures, conduits and appurtenances necessary for that purpose.—Such development may be by the State, *or by a lessee of the State,* (the italics are ours), under a lease for a term not exceeding fifty years, to be secured pursuant to law on such terms as will best protect the public interest, and transmission lines may also be constructed, maintained and operated on such lands by the State, or by a lessee of the State, on like terms."

So there you have it; and for cool effrontery, in its deliberate attempt to take from the public that which the constitution has expressly reserved for its use, this proposed amendment can hardly be surpassed.

For look you, whereas the present law expressly forbids the leasing of State-owned lands within the Forest Preserve to any corporation, public or private, this amendment permits the leasing of such lands.

Whereas the present law limits any storage lands in the Forest Preserve to the supply of water for municipalities, canals and the regulation of streamflow, this amendment permits the building of conduits, power houses and electric transmission lines on these Forest Preserve lands.

Whereas the present law provides that any reservoirs shall be operated by the State, the amendment provides that they may be operated by lessees of the State, *i. e.,* by private corporations.

Whereas the present law contemplates the use of water only, the amendment contemplates the use of large stretches of forest land in the form of clearings for power-houses and wide and lengthy avenues cleared of trees for transmission lines.

This latest raid upon the Forest Preserve is nothing new. More than once during the past thirty years the SCIENTIFIC AMERICAN has raised its voice against the conspiracy, as we do today. Section 7 was adopted in 1894 expressly to save the forests on State land; and from that day to this the lumber and power interests have tried to break down that constitutional safeguard. In 1896 they attempted to pass an amendment which was defeated by a vote of two to one. In 1906 they tried again by last-minute legislation, which passed the Senate on May 1 and the Assembly on the last day of the session. It was denounced by the press and was killed in the next Legislature.

Only once since 1894 has this section been amended, and that was when the friends of the forests prepared an amendment, which was adopted and which permits, as noted above, only 3 per cent of the State-owned forest land to be used for storage for municipal water supply, for canals and to regulate the flow of streams, all of this for State purposes. The Ferris amendment would invade the reserve with power-houses and cut wide swaths through the forests for the erection of unsightly lattice towers and the stringing of cables for the benefit of private interests. They would be protected by fifty-year leases, under which there is no provision for compensation to the State for the valuable rights and privileges granted.

Once more, at the forthcoming general election on November 6, the people of New York State will have an opportunity to register an emphatic "No" to the proposal to open our Adirondack forests for private exploitation.

The Father of Our Modern Navy

How Roosevelt Pulled the Navy Out of the Rut and Gave It a Fighting Edge

By Rear-Admiral Wm. S. Sims, U. S. Navy

IN ANSWER to our request for a Navy Day message, Admiral William S. Sims has written this fine tribute to the share of Theodore Roosevelt in the upbuilding of the United States Navy. On no side of his multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect. He was the despair of the reactionaries and the joy of the younger and forward-looking officers of the Navy. To his conviction that nothing but the best is good enough for the Navy we owe, not only the rapid growth of the Navy in size, but, what is far more important, its advancement in efficiency. During the Roosevelt regime our gunnery became equal to the best in the world; our ships were rid of many serious defects; dangerous open turret hoists were abolished; and the whole personnel became thoroughly imbued with the Roosevelt enthusiasm.—THE EDITOR.

FEW people realize the debt we owe Theodore Roosevelt for the development of our national defenses, especially our first line of defense, the Navy. Few realize the historical and technical knowledge he brought to bear upon this subject. The average man on the street does not know, or has forgotten, that during his young manhood, at the age of 24, he published one of the most remarkable historical narratives ever written by an American, *The Naval War of 1812*. It shows an understanding of the fundamental requirements of naval efficiency that few officers of his time had achieved.

The studies required to produce this book enabled him at once to understand the measures necessary to bring the Navy up to a state of efficiency from the deplorable condition into which it had fallen by the time he became Assistant Secretary of the Navy. He knew so well the qualities of material and training that make a ship a reliable battle unit that when our deficiencies in these respects were presented for his consideration, he accepted the criticisms in the spirit in which progress demands that criticisms should always be accepted, and in which they are so seldom accepted by the responsible authorities. He insisted upon a thorough investigation of the actual facts, the fixing of responsibility, and the immediate initiation of the necessary measures to correct our mistakes.

Before his efforts were interrupted by the Spanish War, he had appointed a board of officers to inquire into the causes of our inefficiency in marksmanship, and to recommend methods of training to remedy this. After the war he found himself opposed by officers who pointed to our successes at Manila and Santiago, and who strenuously objected to any public criticism of what they declared was a Navy that left nothing to be desired in the way of efficiency of either material or personnel. He understood so well the conservative attitude of military men that he insisted upon an impartial presentation of the actual facts, and a comparison of these with the target practice records known to have been made in foreign navies. Needless to say, the record of about one hit in 50 shots at the battle of Manila, and of one in about 30 at the battle of Santiago, showed him the seriousness of the situation; and these records contrasted with the astonishing results of the new methods of training in the British Navy convinced him of the necessity of taking the matter in hand himself.

This he did by ordering the new British training methods put into operation, and ordering all gun gear and gun sights changed to make these methods possible with our guns. Within a short time the improvement was so astonishing as to be difficult of belief. The rapidity and accuracy of fire, the "hits per gun per minute," were increased to such an extent as to indicate that in battle we should be able in one minute to land two tons of heavy projectiles against an enemy's hull at a distance of three miles, whereas, formerly we would not have been able to hit an enemy more than twice in an hour's firing. It was an increase in efficiency of over 3,000 per cent.

At the same time he gave his personal attention to the question of ship design. He grasped at once the significance of the new target practice records—the fundamental fact that the big turret guns could make a high per cent of hits at a range at which the few hits that small guns could make would do little damage. He at once advocated the All-Big-Gun ship, the modern dreadnought, but he found, as usual, that the new type was opposed by the Navy Department. This opposition he would speedily have overruled had it not been for a much more serious obstacle—the force of public opinion created by an article by Admiral Mahan advocating the small gun as the principal battleship weapon. This made it impossible for the Congress to approve the dreadnought type. Nothing deterred, he insisted upon an analysis of the subject for the purpose of showing that Mahan's arguments were based upon wholly mistaken information concerning the hitting power of a battleship's heavy gun at long ranges. These conclusions he gave to the press, thus bringing about the surrender of the Chairman of the Senate Naval Committee, who came out strongly for the new type, which was forthwith ordered designed.

Unfortunately the first of these ships were badly designed, and were at once criticized by Commander Key. These criticisms were opposed with all of the power of the principal dignitaries; but Roosevelt, as usual, insisted upon a showdown of all the facts. He caused the whole matter to be discussed by a body of about fifty officers in a conference which he opened in person at the Naval War College at Newport. The result was that the defects criticized were corrected, as far as possible in ships partly built. But, more important still, measures were ordered that would make sure the avoidance of such mistakes in future designs; and since that time the design of our battleships has been second to none in the world.

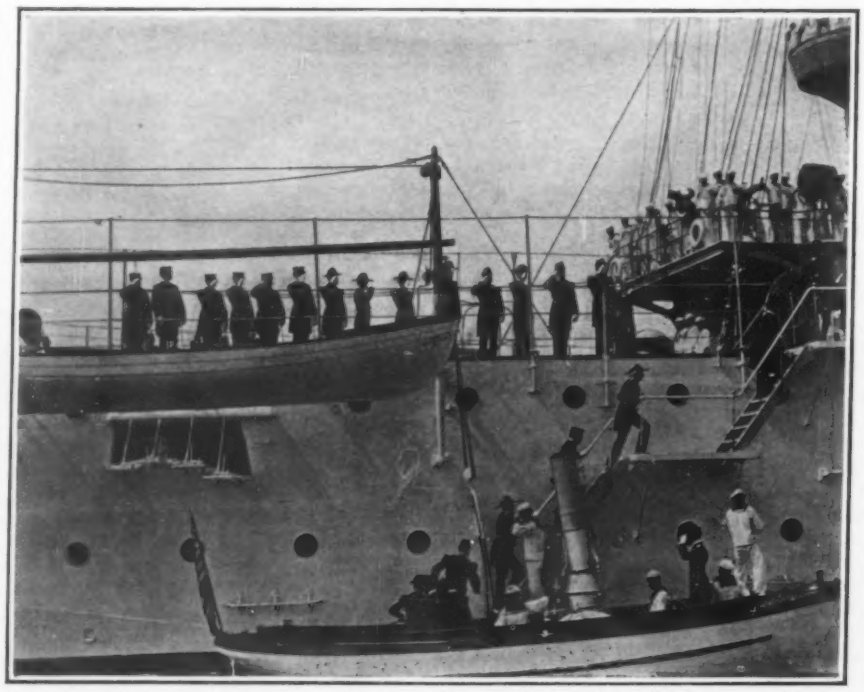
In addition to correcting such vitally important defects as those above indicated, both in design and in methods of training, he gave his attention to many of the major details upon which efficiency depended. To cite but a single example, he used his powerful influence to overcome the opposition to correcting the incomprehensible defect of open turrets—wide open at that time from the gun platforms down to the magazines directly below. The danger of this design had been frequently pointed out, but was successfully denied until it was demonstrated by the terrible turret accidents that resulted in the death of many of our officers and men.

The consternation caused by these horrors was such that the Department actually advocated the abandonment of all efforts to increase the rapidity of fire of our heavy guns, and advised that the records of our competitive target practices should be based upon the percentage of hits only. In this crisis Roosevelt showed a comprehension of the wholly essential element of battle efficiency indicated by the phrase "hits per gun per minute," the standard of comparison then in use in our target practices. In a stinging letter he gave orders that we should continue to make every effort to increase the rate of hitting—to put more hits into an enemy's hull than he could put into ours in a given interval of time; and he made it clear that it was up to the Navy to risk any dangers that such training might involve.

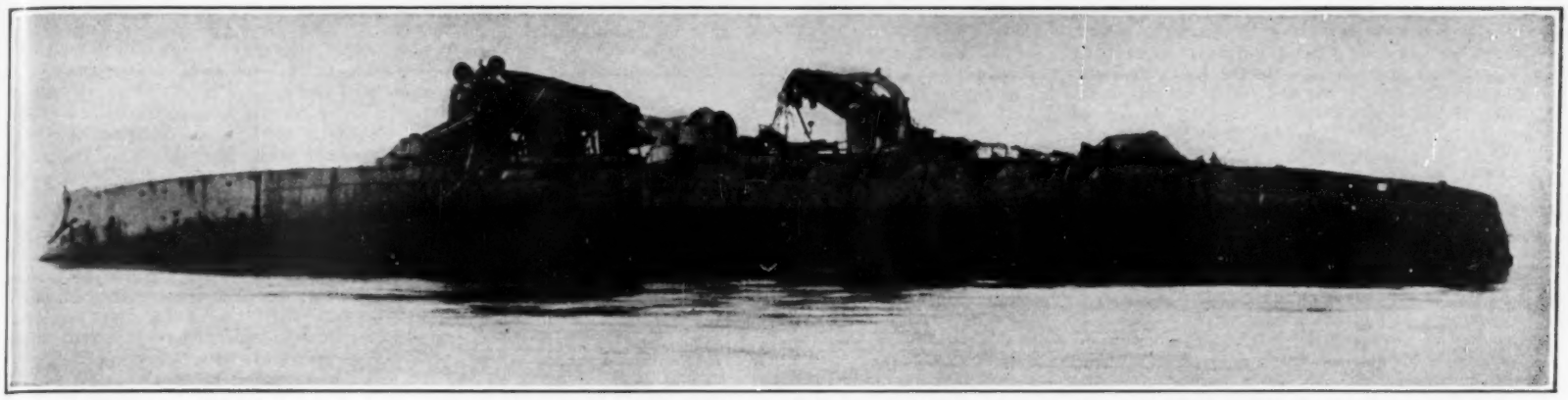
But more important still than the essential changes in design and methods indicated was the change wrought by the great spirit behind it all. In no line of his multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect. He was the despair of the reactionaries and the joy of the younger and forward-looking officers of the Navy. Every man on every ship, from the captain down, soon realized that there was a master mind insisting that nothing but results should count; that "the only shots that count are the shots that hit." Since then we have had a new Navy—a Navy whose officers insisted upon efficiency, and therefore temperance, long before it was generally realized that the maximum mental alertness and manual dexterity necessary to efficiency in dangerous occupations cannot be achieved by men addicted to the cocktail habit.

This great man jarred the old-time Navy out of its complacent conceit. He well understood, and tried to make the Navy realize, that the greatest danger in a military organization is dry rot, resistance to progress, and the substitution of a comfortable administrative routine for preparation for war. He was never tired of quoting the remark of a disgusted bureau chief who complained that "my department was running smoothly and perfectly until this damned Spanish War came along and upset everything."

It is fitting that the birthday of this remarkable man should have been selected as our National Navy Day. He was the father of our modern Navy. He instilled into it a spirit that brought into play the dormant, sterling qualities of the personnel. He gave the word efficiency a new meaning. He cared nothing for show; he was not impressed by spotless decks and the polished gear of guns that could not shoot fast and straight. He was impatient of ceremony. He stuffed cotton in his ears, went into the fighting tops of battleships and had his hat blown off by the blast of heavy guns. He went down in submarines. He thus made his interest as real to the youngest gob as to the senior admiral. All understood that he valued the Navy only in proportion to its demonstrated ability to defeat an enemy in battle. He gave it the fighting edge. Though he is dead, this remains; for his spirit still lives and will always be a cherished tradition and an invaluable inspiration in the day of battle.



President Roosevelt (seen at top of gangway) returning official call of Commander-in-Chief, United States Atlantic Fleet, on board flagship "Tennessee" at naval review off his home at Oyster Bay in 1904



The "Virginia" as she rolled over to starboard before sinking in the September, 1923, tests. Bombs that dropped aboard threw down the two lattice masts and the three smoke stacks. It should be remembered that the ship was anchored; that she had no anti-aircraft guns; and that the bombs were dropped, without interference, from the low elevation of 3000 feet

Has Sea Power Passed?

An Authoritative Exposé of the Extravagant Claims of the Air Enthusiasts

By Rear-Admiral Albert Gleaves, U. S. N.

SO MUCH publicity has been given to the alleged performances and capabilities of aircraft as an argument against the continued development of our Sea Power, that the Navy Department has uttered its official protest against the repeated attacks of the air enthusiasts who contend that Air Power is not only an extension of the Fleet, but that it has actually superseded it and rendered the battleship obsolete.

In the July number of the *Fortnightly Review*, Mr. Archibald Hurd says that the doctrine that Air Power has rendered Sea Power more or less obsolete involves not only the extinction of the Navy but the extinction also of the Mercantile Marine, "and we are offered nothing in place of the one or the other, which can be regarded as satisfactory; for the airplane has a very short radius and the airship is still a thing of the future; both are indeed in the experimental stage." He points out that as airships have to sustain their own weight as well as the cargo, while the surface ship is borne by the water; that airships can never replace merchant ships, and the extinction of merchant ships would be the extinction of trade.

This is not written to discredit aircraft, but to warn against what President Roosevelt would call the "mischievous folly" of those who assert that our national defense and offense has passed from sea to sky. Every sane man believes heartily in the so-called "Three Plane Navy," aircraft, ships and submarines, and even naval airmen repudiate statements to the contrary.

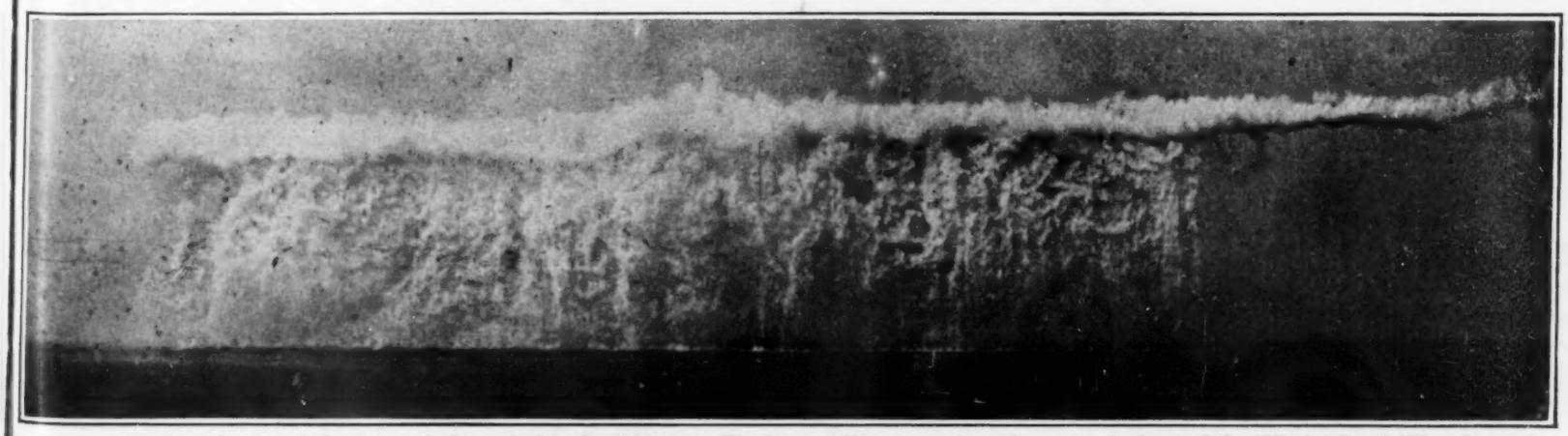
The air enthusiasts base their arguments mainly on the bombing experiments against the Alabama and Ex-German ships off the Virginia Coast, July, 1921, and reinforce their opinions with those of certain British Naval Officers. The controversy they have projected contains many factors, which if carefully examined, will expose the fallacy of their impeachment of battleships, guns and forts. Recognizing the immense importance of aircraft, our duty toward Air Power is plain. We should, *(1) Put aircraft of the right kinds and as many as possible on every surface ship belonging to the Navy; (2) Build all the aircraft carriers we are allowed under the treaty and operate them with the fleet;* (3) Augment the Navy with 10,000-ton *cruisers* and 10,000-ton small "carriers" *of such type* (if there be one) as the limited displacement permits; Provide fixed air base defenses for the Canal, for our naval bases and for our great commercial ports, navy yards, and other vital positions. If we do these things we will have done everything the air development of the day warrants. More than this we cannot do under the Treaty.

When the Conference for the Limitation of Armaments met at Washington, the United States was on the eve of becoming the greatest Sea Power in the world, a consummation naturally not pleasing to England which had held the trident of Neptune for 600 years, or to Japan which aspired to be in the Far East what England is in Europe. It will be recalled that the Conference agreed to restrict the number of battleships and airplane carriers; certain tonnages were also restricted as well as the size of guns. With few exceptions, American Naval Officers will remember the Conference with a pang of regret. To the air radicals, however, it was a boon. "We have enough battleships," they say, "forts are useless, and the only proper defense of our bases is by airplane, submarines and mines."

In every discussion of the question the air-enthusiasts present visionary, not to say fantastic, pictures to prove that Air Power has conquered the sea and eclipsed the battleship. A recent article describes the annihilation of the United States Fleet of 12 modern 30,000 to 40,000 ton battleships, and the fortifications at Honolulu, by a Japanese Fleet of 12 plane carriers of 10,000 tons, *35 knots speed*, each carrying 50 bombing planes. It is interesting reading and would make a good film story, but will unfortunately confuse and mislead the lay mind. The fact is a 10,000-ton carrier such as described could not possibly stow 50 huge planes with personnel and equipment. It is practically certain such a ship, so far as may be seen now, could carry only a few bombers *and could not launch any.* In the "battle" the shore defences are allowed only a "few" planes, and our fleet none at all except the light planes carried in the "Langley."

The air enthusiasts when confronted with the poor record of aircraft in the North Sea, retort: "Air Power did not appear at Jutland; today it dominates in warfare." Air Power did appear at Jutland and before; the Germans had highly developed airships at the beginning of the War and the English had airplanes. It was an airplane that discovered and reported the approach of Von Hipper's battle cruisers, and was driven off by gun fire when it attempted to bomb the German ship. As early as November, 1914, an attack by seaplanes was planned upon the Zeppelin sheds at Cuxhaven; but in the prevailing weather the planes could hardly get off the water. (World Crisis, p. 490). The failure of his aircraft to locate Jellicoe's Fleet delayed Von Scheer eight days and changed his whole plan of campaign. Air Power failed at Jutland and in Heligoland Bight, because aircraft could not operate in a fog, nor can they now. They would have failed at Coronel for the same reason. The high speed of the battleships and cruisers in all the actions of the War—23½ to 28 knots—makes it doubtful if, with their present sighting appliances, airplanes could have succeeded either in the North Sea or in the southern oceans. They were of some service at the Dardanelles when a balloon was used for spotting the shots of the Queen Elizabeth across the Gallipoli Peninsula, and it was a success there only because it was used as an adjunct to Sea Power. Air Power and Sea Power are so interlocked and interwoven as to be inseparable.

Opinions of distinguished British Naval Officers are quoted to impeach the battleship. Lord Fisher is the principal witness. He is quoted as saying, "'Scrap the lot—referring to battleships.'" One wishes that, in the interests of truth, chapter and verse had been given for this quotation. He did say once, and the expression



Smoke screen cast by one of the Army airplanes during the 1923 tests. The heavy falling gases formed a screen in front of the "Virginia" and "New Jersey," rendering the ships barely distinguishable in the distance

has been often repeated, "Sack the lot," but he was referring to reactionaries in the Admiralty, not to battleships. On another occasion he wrote in 1915, "I am busy scrapping parasites," ("In the North Sea with Beatty") again referring, not to material but to personnel. Lord Fisher was a strong advocate of aircraft as *auxiliary* to the Fleet (Memoirs) and he regarded "The Fleet ready for action as a National Life Preserver" (Letters to Edward VII).

The enthusiasts of the Air School even invoke the spirit of Mahan in their impeachment of Sea Power. It is impossible to conceive the great apostle of Sea Power as denying the doctrine he preached for 30 years, or looking upon super-dreadnaughts as "shadows of the past," as an air enthusiast puts it. Could he speak on the subject he would probably say, as he did when he approved the use of gas shells, modifying his words to suit the new invention: No airplane capable of carrying a bomb of sufficient capacity, or of propelling it with such accuracy as to sink a battleship under *war conditions* is as yet in practical use, or has undergone adequate experiment; consequently we are ignorant of the facts as to whether the results would be of a decisive character or whether injuries in excess of that necessary to the end of warfare, the immediate disabling of the enemy, would be inflicted. Captain Mahan was a true prophet when he foretold that the Zeppelins would be found to be greatly overrated. (Life of Mahan. Taylor).

WE have long been of the opinion that there are few deficiencies in the makeup of the average man that are so destructive of clear thinking as the lack of a sense of proportion. The latest proof of this is to be found in the columns of arrant nonsense that are being printed these days, about the doom of the battleship and the dominance of the airplane. A few airplanes drop bombs on an anchored and defenceless old battleship and, presto! all battleships, even if they are moving swiftly and bristle with antiaircraft guns, are forever helpless. With indisputable facts and remorseless logic, Admiral Gleaves in this article punctures the airplane fallacy.—THE EDITOR.

From one era of invention to another there must be a transition period of try-outs and experimentation. We do not abandon a perfected weapon and replace it by an undeveloped invention; the radio has not yet replaced the telegraph and the telephone; and fifty-odd years intervened between the fight of wooden ships at Hampton Roads and the battle of the super-dreadnaughts at Jutland. It may be we are at the threshold of a new era, and the airplane model of 1980 may be an armored battleplane of 100 tons, 12,000 horsepower and 200 knots speed, carrying 50-ton bombs, as foreseen by M. Bréquet; but in the meantime we must be prepared to win a war with weapons in hand. The Navy, which is our first line of defense, must be kept up to the highest efficiency, equal in all respects to that of Great Britain, and five-thirds of Japan's. It is unfortunate that the Limitations Treaty did not make this obligatory.

The Bombing Experiments of July, 1921.—These tests, which have started so many controversies, in no respect simulated war conditions; and this is largely true of the tests recently carried out against the "Virginia" and "New Jersey." The 1921 experiments were postponed from time to time until the weather was clear, the sea smooth and the wind light. In all, 75 Army and Navy planes were used. They flew low down over stationary, defenseless and abandoned ships, and, undisturbed, dropped bombs of 150 pounds to 1000 pounds of high explosives. In 1923 the "New Jersey" was sunk at 6000 feet and the "Virginia" at 3000 feet. Today we have machine guns and light guns that can spray the air with aimed projectiles at these elevations.

According to the report of the Joint Navy and Army Board on the 1921 experiments, the practice was not as good as was to be expected under the selected favorable conditions. It is a fact that it required 9 hours and 37 minutes to drop 78 bombs (26,851 pounds) on to a cruiser and destroy it, much more time than it took Jellicoe to sink by gunfire one battleship, one battle cruiser, four light battle cruisers and five destroyers and kill and wound 2800 men.

The "Ostfriesland" was sunk by the mining effect of bombs which fell close alongside; this brought out nothing new because it was well known that mines can and have sunk ships; but ti is not so generally known that unless the explosion is practically in contact with the side or within a few feet of it the effect is not serious. Even if a ton of T. N. T. were exploded 100 feet from the ship's side the effect would be equivalent to the explosion of only 2¼ pounds alongside; not enough to injure a torpedo boat. To argue then that the sinking of the "Ostfriesland," which, be it remembered, was unresisting, practically at anchor, no one on board to pump out flooded compartments, and not provided with the latest under-water protection, "proves that if our coast is protected by airplanes no ships can reach our shores or land troops" is an example of special pleading which would not be admitted in a court of law.

In discussing this practice it should be remembered that the difficulty of getting hits with bombs or aerial torpedoes is vastly increased when the attackers meet opposition. It is one thing for an airplane to stand toward a defenseless target and, at its leisure, drop its bombs or torpedoes, but quite another to maneuver this way and that in the approach; fight off defending planes; and drop missles accurately. Sights must be set for every change of course of the planes and to set them accurately requires some steadying on the new course. Thus, when attacking a *defended* ship *accuracy* is enormously reduced and the per cent of effective hits becomes very small. Could airplanes get 100 per cent of hits (which is utterly impossible) in practices like that at the "Ostfriesland," it would not prove they could get 5 per cent of hits when attacking against opposition.

One of the recent claims of air enthusiasts is that *altitude* does not play a great part in the accuracy of bombing. They claim that with improved sights bombing from altitudes of 5000 to 8000 feet can be quite accurate, in fact more accurate than from lower altitudes where the plane is under anti-aircraft gunfire. It is obvious that a bomb dropped from an airplane has an initial vertical velocity of zero, and being propelled downward only by gravity cannot have the accuracy of a shell fired with an initial velocity of 3000 feet per second. The low velocity, of course, greatly increases the errors due to wind, speed of airplane, speed of target and earth drift. Nothing but the high initial velocity of gun fire can minimize these factors; therefore air bombing affords no reasonable basis for the claim that the battleship is doomed. With the improved sight the chance of hitting a vital spot, the conning tower, for instance, is slim even at low altitudes, when opposed and within anti-aircraft gun range. The probabilities by trial and error of hitting the deck of a large ship decreases from 50 per cent at 1000 feet altitude to 17 per cent at 8000 feet.

Airplanes carry from 500 to 1000 pounds of T. N. T. Planes carrying 4000 pounds are contemplated, but do not exist today. The heavyweight bombers cannot yet be launched from plane carriers and must be operated from shore. Heavy weights carried by bombers limit the radius of action to 500 miles at the comparatively low speed of 85 to 100 miles per hour. It is evident such planes are greatly handicapped in attacking ships at sea. As *one* plane can carry but *one* large bomb or torpedo, when that missle is launched the plane must return to the base or to the carrier for a reload. Air enthusiasts seldom admit this fact into their calculations. Also they assume that planes can go to and fro direct between the base or carrier and the target ship when, as a matter of fact, they have to *search* for their objective—*and do not always find it.* Leaving these considerations out, air attacks become easy on paper. Naval aviators and officers who practice with aircraft actually or on the maneuver board recognize these points; there are some others who do not.

Airplane Carriers.—The big carriers will be equipped to carry 110 planes of various types; but the trouble with the carriers is that as yet they cannot launch heavy bombers, nor can the other types land or take off in rugged weather. To operate airplanes from on board ship the sea and weather conditions must be favorable. In launching or taking on planes, carriers must point nearly into the wind. This is seemingly a minor point; but it is amazing to what extent that little fact interferes with the airplane. It often makes carriers go where they don't want to go and do what they don't want to do. Hence carriers cannot always launch and take on planes at the time they wish. If the wind is *fresh* or even moderate they must steam very slowly into it to get their planes off. If enemy surface ships are near, carriers have to run fast and frequently not to windward. At such times they can't handle planes at all. It often takes the whole battle line to protect carriers while they are launching planes or taking them on. Air enthusiasts don't seem to have ever heard of this fact.

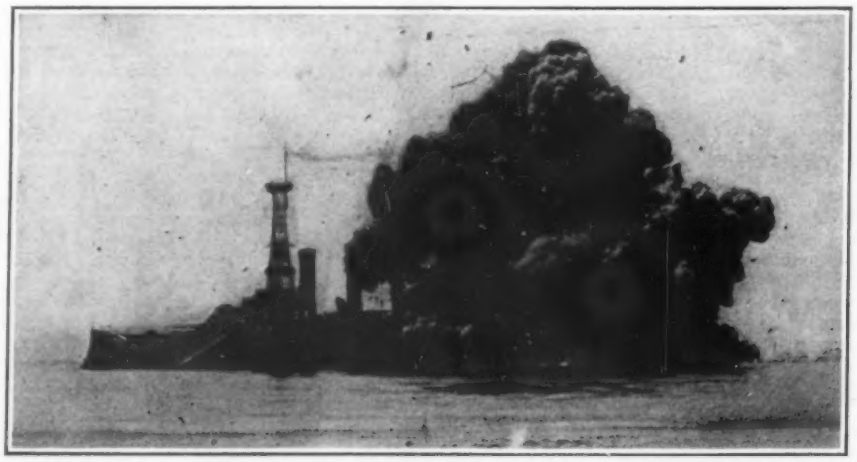
Another point that the air radicals never consider is the time it takes to launch planes from a carrier. Carriers can launch planes only one at a time, as very few planes can be kept on deck ready to take off; the rate of launching will probably not exceed one in four or five minutes.

Torpedo Planes.—The airplane torpedo weighs about one-half ton and therefore can, as yet, be launched only from planes sent up from shore. Although not fully developed the torpedo plane has great possibilities. Already the air enthusiasts are making extravagant claims for it. They say that the carrier is the equivalent of a gun that will shoot 100 miles, and discharge a projectile containing hundreds of pounds of explosives. They explain that the carrier having chosen its distance, 100 miles or so from the enemy fleet, will send up its torpedo planes which will attack at dark or dawn, when within torpedo range (5000 yards) fire their shots *unobserved* by the enemy! They do not say how the carrier or planes are going to escape detection by a vigilant enemy who will be protected by a screen composed of submarines, destroyers and aircraft, *thrown out at a distance of 30 miles* from the battleships and the "train."

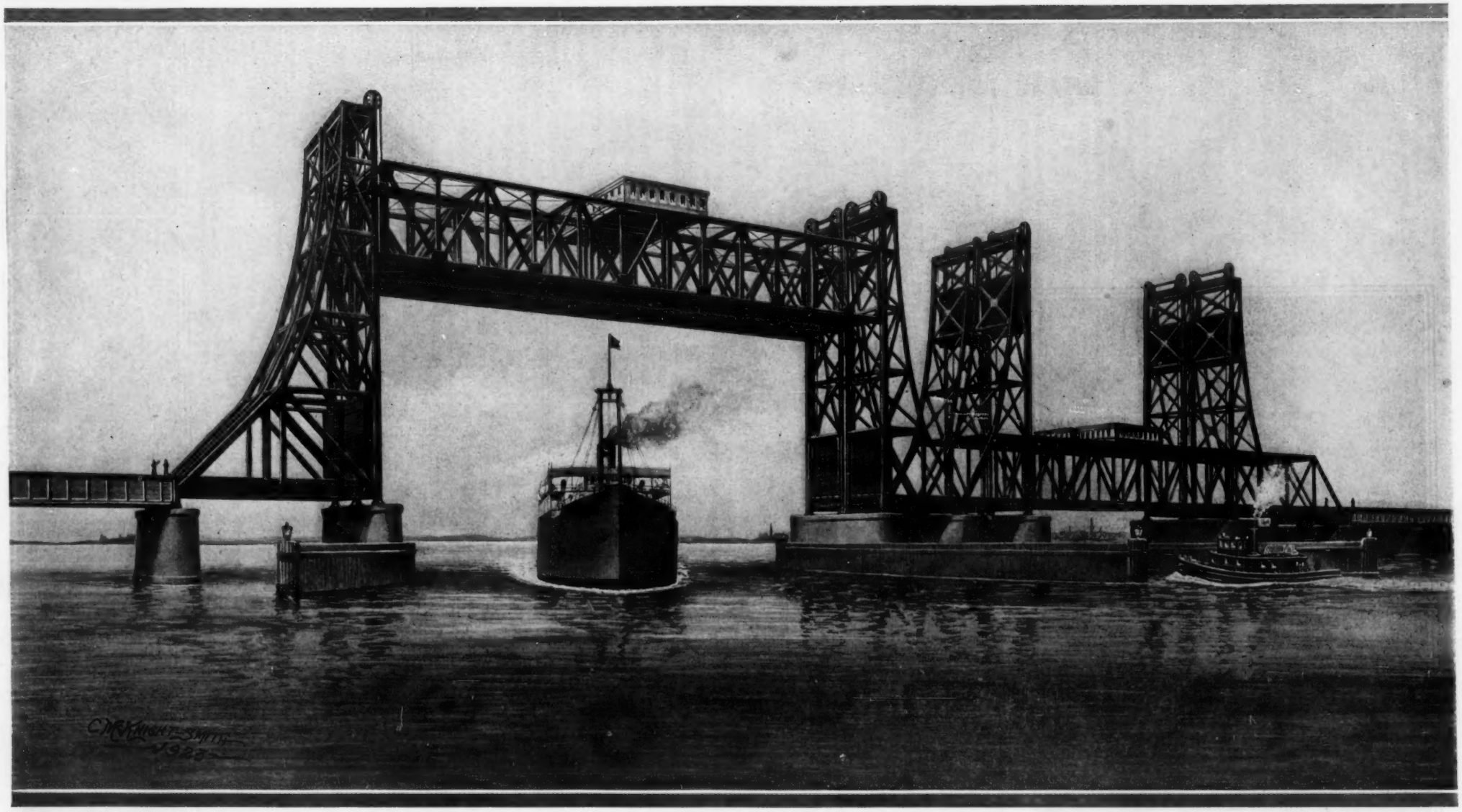
The effectiveness of the torpedo plane has only been partially tested in war. In a recent target practice torpedo planes fired 18 shots at the "Arkansas" which was zigzagging in *smooth* water at a speed of 15 knots, and scored 44 per cent of hits; of course conditions were totally dissimilar from war, and were all in favor of the planes. As the planes had to come down within 20 feet of the water to release the torpedo, and as the range was only 1000 yards, under war conditions they would easily have been destroyed by gunfire. This practice was justly considered encouraging, but an air enthusiast called it "an appalling success."

It is often claimed that if we were "amply provided" with airplanes, but had *no battleships or forts*, the planes alone could prevent a landing and invasion by an enemy. This can only be a matter of opinion which cannot be verified. What would be an "ample" number of planes? Assuming that one per cent is the basis in the Army (*i. e.*, Army of 500,000— airplanes 5,000) and that each Naval District will have an active Naval Air Station for defensive sea patrol, scouting operations, etc., and that the cruisers have their full allowance, a hostile landing could be made difficult, but not impossible; nothing more definite than this can be predicted. Counter aircraft attack must be considered, and this is rarely, *if ever*, done by the air enthusiasts, who generally give the "attacker" all the planes he could wish without considering the practical details of getting them into action. It would be interesting to figure out, on a percentage of hits basis, how many

(*Continued on page 372*)



Bomb falling in the water near the "New Jersey." Such bombs, if they detonate sufficiently close to the ship, are more fatal than those which make a direct hit



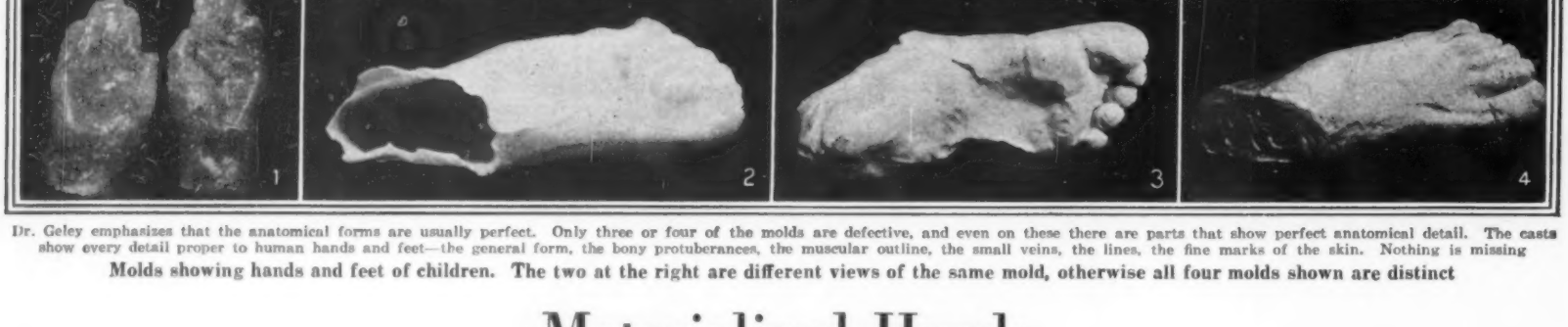
NEW LIFT BRIDGES ON THE JERSEY CENTRAL RAILROAD ACROSS NEWARK BAY

SEVERAL of the railroads which have their New York terminals in Jersey City or Manhattan have to cross the Hackensack River or Newark Bay when they enter or leave the meropolitan area. In the case of the Central Railroad Company of New Jersey, this necessitates a long crossing in a location which intercepts the water-borne traffic to and from the City of Newark, with its large manufacturing interests. Consequently, the War Department calls for the provision of some form of opening through the bridge to permit the passage not only of tug boats and lighters but also of the large sea-going vessels whose terminals lie in the upper reaches of Newark Bay. In the past the bridge had to be opened for the majority of the water-borne traffic; and this has resulted in frequent delays of the railroad service. The new bridge will obviate this delay.

Hitherto, the railroad has been served by a timber trestle track, with a swing bridge over the main channel; but lately it became desirable to replace the old bridge with a steel structure of thoroughly modern design. The new bridge which carries four tracks is located 100 feet north of the present structure. The track level will be 30 feet above that of the present bridge and 40 feet above mean high tide. This raising of the level will provide a clearance of 35 feet above mean high water, when the lift bridges are in the lowered or closed position, with the result that 75 per cent of the water-borne traffic will be able to pass under the bridge when it is closed. Moreover, very little of the traffic will require a full lift of the bridge.

In the Newark Bay crossing, the Central Railroad Company has provided two channel openings, one (the further one in the illustration) having an opening 125 feet in the clear and the other a 200-foot opening. Except as to dimensions, they are identical. It will be noticed that on each side of the channel opening is a lofty, steel, framed tower presenting a vertical face to the opening. Each tower rests upon two piers, one on the edge of the channel and the other placed back of it, at a sufficient distance to provide a broad base for the tower. Each tower consists of four vertical trusses of great strength and rigidity. On the inner faces of the towers, adjoining the channel, are four vertical guideways, in which the ends of the movable span of the bridge travel, when it is raised or lowered. The lifting is done by means of eight heavy cables which are attached to the bridge, pass over the heavy pulleys at the top of the towers, and are attached to massive counterweights, which in the 200-foot span are shown at the bottom of the towers, and in the smaller span, which is shown in the lowered position, will be noticed near the top of the towers. The counterweights are so nicely adjusted, that the raising or lowering can be done by electric motors of moderate power, which are controlled from the operating room, located on the top chords of the bridge. The excess weight of the spans is so small that the bridges can be raised to their full height in two and a quarter minutes. It should be mentioned that when they are in this position, there will be a clearance of 135 feet below the underside of the spans at mean high-water, which is about the same clearness as that of the center of the Brooklyn Bridge over the East River. This will be ample to clear the masts of such deep-sea ships as may wish to pass through the bridge. The approach spans will be steel girders 125 feet in length, which will be supported on concrete piers laid on pile foundations.

The foundation work for the new bridge is extensive and involves a large amount of dredging, caisson work and laying of concrete. The massive piers for the lift bridges will be carried down to rock at a depth of 60 feet below water. The piers for the approach spans are built of concrete on pile foundations. The necessary excavation is being done by a dredge with a cutter seven feet in diameter, which is capable of handling from 5,000 to 20,000 cubic yards per day. The excavated material is pumped ashore and used for filling at one end.



Dr. Geley emphasizes that the anatomical forms are usually perfect. Only three or four of the molds are defective, and even on these there are parts that show perfect anatomical detail. The casts show every detail proper to human hands and feet—the general form, the bony protuberances, the muscular outline, the small veins, the lines, the fine marks of the skin. Nothing is missing

Molds showing hands and feet of children. The two at the right are different views of the same mold, otherwise all four molds shown are distinct

Materialized Hands

The Franek Kluski Wax Molds, and the Conclusions that May be Drawn from Them

By Dr. Gustave Geley, Institut Metapsychique International

Translated for the SCIENTIFIC AMERICAN by Stanley de Brath, M. I. C. E. (British)

MUCH reference has been made, in psychic controversy of the past two years, to the paraffin casts of hands and feet obtained by Dr. Geley in the presence of the Polish medium Kluski. We think it probable that the bare existence of these molds has been known to most American readers interested in psychic matters. But when Mr. Bird was in Paris and saw the originals, he realized at once that no adequate account of them had appeared in America, if indeed at all in English. He accordingly arranged with Dr. Geley for a comprehensive article describing the molds, the mode of their production, and the procedure of the French investigators in reaching the conclusion that they were genuine. Dr. Geley has sent the manuscript, for translation, to Mr. de Brath, who rendered into English Richet's monumental treatise "Thirty Years of Psychic Research," and who is himself one of the leading British spiritists; and in this way our readers are assured of a translation that shall not suffer through any lack of special knowledge of the subject on the part of the translator. Whether or not our readers are prepared to follow the author in all his conclusions, they must realize that he presents a psychic document of the utmost importance.—THE EDITOR.

THE STORY of materialized human members constitutes one of the most interesting episodes in the progress of metapsychic science. The sharp definition and precision of the results obtained, and the impossibility of attributing them to any kind of fraud, make them one of the most incontrovertible proofs of the reality of ectoplasmic manifestations. We may here remind readers in what these ectoplasmic manifestations consist: They are a kind of exteriorization of the physical personality of the medium. During trance a portion of his organism is externalized under the appearance of an amorphous substance which may be either solid or vaporous.

This amorphous substance then takes organic forms, and from it or in it there appear new forms, which, when the phenomenon is complete, are capable of assuming all the anatomical and physiological characters of living organs. The ectoplasm has then become a living being or a portion of such a living being; always, however, closely connected with the body of the medium, of which it is a kind of prolongation, being re-absorbed into his body at the close of the manifestation.

The phenomenon is assuredly objective. It cannot possibly be explained by hallucination or illusion of the experimenters. This is *proved* by photographs and molds taken in wax. These wax molds are specially interesting. They reproduce the exact form of the materialized member and allow the thorough examination of every detail.

The materializations being very short-lived, only a very rapid process can be used to get casts of them. The best, or rather the only known method fulfilling the necessary conditions, is by utilization of melted paraffin wax. This method was invented in 1875, in America, by Mr. Denton, a professor of Geology. It was also employed in London by Mrs. Reimers and Mr. Oxley, who obtained excellent results. Since then, as far as I know, no medium has, till lately, been found capable of giving these molds; for the very good reason that none have produced complete materializations having three dimensions (length, breadth and thickness), a complete anatomical structure, and lasting long enough to allow of the operation of molding.

For this operation, a tank is provided containing paraffin wax kept at melting-point by floating on warm water. It is placed near the medium during the séance. The materialized "entity" is requested to dip a hand or a foot, or even a part of the face, into the melted wax, repeating this two or three times. A coating of wax is at once formed, closely adherent to the part so dipped. This coating hardens very quickly in the air, or by being dipped into cold water provided in a neighboring tank; then the hand or other organ is dematerialized and the "glove" remains behind. This "glove" is afterwards filled with plaster of Paris; and the cast is freed from paraffin by placing the whole in hot water. We then have a cast reproducing the materialized organ in every detail.

I shall here speak only of the experiments at the International Metapsychic Institute, referring the reader to the books by Professor Aksakoff (Animisme et Spiritisme) and by Delanne (Les Apparitions Materialisées) for the story of the earlier experiments. Our molds of materialized human members were obtained through the mediumship of Mr. Franek Kluski, during the course of the years 1920, 1921 and 1922; at first in the laboratory of the Institute, and afterwards at Warsaw.

In Paris, the laboratory is a large bare room without windows. The doors were bolted from the inside. A dull red light enabled us to observe any movements by the medium. Mr. Kluski, before entering the laboratory, turned out his pockets, and I satisfied myself that he had no box or any other object in his possession. The experimenters, who were always few in number (Professor Richet, M. de Gramont, Count Potocki, and sometimes Colonel Okolowicz), sat around a table, on either side of the medium. Both his hands were held, by Professor Richet or M. de Gramont on one side, and by myself on the other. The medium soon fell into trance; his head resting on the shoulder of one or other of the persons next him; and made not the slightest movement. A luminous phosphorescent cloud proceeded from his body, especially from his head, organic forms appeared in condensed portions of this cloud of vaporous ectoplasm, and soon developed into hands and faces having all the appearances of life.

To obtain molds the tank containing the melted wax was placed on the table before the séance, two feet from the medium. The molds were formed on request. The operation usually began after a wait of some 20 minutes, and was accomplished very quickly—in one or two minutes. This somewhat surprised us, as paraffin wax at the temperature of the room does not solidify so quickly. According to Dr. Kluski, it would seem that the operating entities can alter the temperature of the member in the mold at will, and can cool it sufficiently to cause the paraffin to solidify; we give this explanation as given to us, only remarking that the hands of a medium in trance often become suddenly and considerably cold.

The operation took place in two or three stages: the acting hand plunged into the tank, came out covered with warm wax and touched the hands of the experimenters; then dipped again into the tank. After this, the glove, still warm, was put down, usually against the hand of one of us. We obtained one or two molds at each séance. Later on, at Warsaw we sometimes had three. In all, through the mediumship of Mr. Kluski we have had 25 molds; of which 17 are of a single hand, five of two hands joined, two of feet, and one of the lower part of a face.

The size of the molds varies; some are full-sized male and female hands, some are those of children of 10 to 12, and some smaller, corresponding to hands of children from five to seven. In detail, there are seven hands of children of five to seven years old; one foot of a child of that age; and one corresponding to a child of 10 to 12 years old. All the other organs are those of adults.

The molds are all in a single piece without the slightest joint, even when of

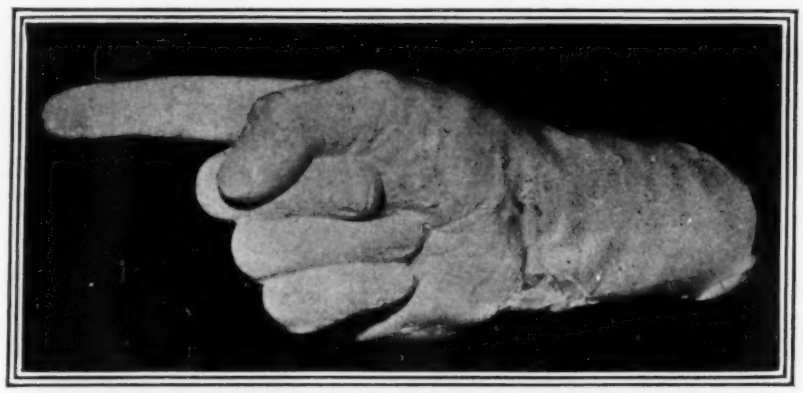
Two separate molds showing two hands joined

a hand up to the wrist. They are all extremely thin, the wax being only a millimeter thick and often much less. The walls of the molds were in places so thin that in drying they developed small cracks from which portions of plaster escaped during the subsequent casting. We call particular attention of readers to this tenuity of the skin of wax. We have shown these casts to artists, painters, sculptors, molders and medical men. All have unanimously agreed that they are casts from human hands. One report from eminent artistic molders—Messrs. Gabrielli, Marchetti and Marettini—says:

"Our third remark is on the delicacy and truth of the anatomical detail. Life is to be felt under these strange and deceptive casts. It is obvious that these molds have been made from *living hands* . . . . We find in them not only the anatomical details but traces of muscular contraction that can be explained only by movements directed by will. There are slight crumplings of the skin which leave no doubt on the subject . . . .

"From our long and minute examination we are compelled to conclude that molds so perfect, with such delicacy of detail, with indications of active muscular movement and folds of the skin, could only have been obtained on a living hand. They are molds taken at one operation, originals and not made from impressions."

Our certitude of the metapsychic origin of our molds rests on several proofs, some of which are absolutely incontrovertible. First we have the proofs based on control of the medium. We have stated above under what measures of control the molds were taken. The chief of these—the strict holding of both his hands—should produce complete conviction. We can affirm that during the séances the medium could not at any time have used his hands for trickery. I always myself held one of his hands and am quite certain that I never released it. Still further, in the experiments at the Institute it often happened that Professor Richet and I, controlling the medium, approached our hands holding those of the medium until they were in contact. Under these conditions, when we both could be quite certain, without any possible doubt, that Kluski's hands were completely immobilized, molds were produced. Further, as previously stated, we several times observed the simultaneous molding of two hands, clasped together. In such cases, it would have been necessary that the medium, to make molds of his two hands, should liberate both at the same time. This was absolutely impossible. As for the supposition that the medium could trick by making such perfect molds by using something other than his hands, this is so absurd that it does not deserve discussion.



Child's hand, reduced about one-third from the original. Here perhaps more than in any other single cast the impossibility of normal removal of the original from the paraffin appears

A second consideration is the proofs based on examination of the casts. We have already shown that our molds were indisputably made on living human hands. This at once disposes of the hypothesis of a fraud by aid of an India-rubber glove. We have endeavored to reproduce similar molds from an India-rubber glove distended with water, dipped into paraffin, and emptied for withdrawal.

An exceptionally fine adult female hand, on which the paraffin shell is no thicker than cigarette paper

This can easily be done, although with air the experiment fails as the thing floats on the top of the paraffin. The coating of paraffin must be thick enough to prevent fracture on withdrawing the rubber. But the result obtained is characteristic of the process used; there are none of the precise details of the human hand, and even its general appearance is absurdly deformed—a caricature of a hand. This deformation is inevitable when we are using India-rubber or any supple object. Even supposing an artificial hand artistically prepared so as to reproduce the lines of the palm, the creases of the skin and the nails all complete, this simulacrum *could not be distended with water without completely deforming it.*

We think ourselves able to assert that it is impossible to imitate our results with flexible India-rubber. Could they be imitated by using a hard object instead of a flexible one? All our endeavors to do this have been fruitless. The object could not be released from the coating of paraffin, which always broke or was hopelessly deformed. In vain did we give the waxen glove considerable thickness to give it resisting power—a thickness out of all comparison with that of our molds. We greased the thing carefully and made a long slit in the narrower portion representing the wrist, so as to facilitate withdrawal, but in vain. All these artifices produced no result. Even if we admit that others might be more skillful or more lucky than we were, we should none the less be justified in asserting that it is not possible by using a hard object to produce paraffin gloves analogous to our own both in respect of form and thinness.

But another question immediately occurs. Can these super-normal molds be imitated by using a normal living hand? The answer is easy. It can be done; indeed there is no other fraudulent process possible, but this process is both imperfect and very difficult. We took every precaution against trickery of this kind. This, however, necessitates a long explanation.

The first point to be cleared up is—How can these supernormal molds be imitated, using a normal living hand? We know two methods that can be used. The first and simpler, consists in plunging the hand into warm paraffin several times and awaiting the complete solidification of the glove (which takes 15 to 20 minutes in the air and from six to eight minutes in cold water). Then an incision is made with a razor or sharp knife along one of the edges, from the base of the fingers as far as the wrist. The hand can then be released by small lateral movements which detach it little by little from the waxen glove. The edges of the incision are then brought together and quickly re-dipped into the paraffin to conceal the joint and thus get a mold in one piece.

The joint does not show much if the operation is well done; but in order that it may be successful, one condition is indispensable—the glove must have 10 to 20 times the thickness of the super-normal molds. We have been unable by this process to obtain *thin* gloves, because these were always fractured on withdrawing the hand. Further, this process can only be applied to an extended hand. It would be quite impossible with one in the positions in the more surprising photographs shown. Also careful scrutiny always shows some traces of the joint. It can therefore be affirmed that this process could not have been used by the medium, even if our control had not placed an insuperable obstacle to its employment.

The second fraudulent process is more complex. It consists in using the hollow mold of a human hand. Into this mold some substance such as melted sugar, both fusible and soluble, is poured. When solidified it is removed from the mold and dipped into the paraffin; it is then placed in a tank of cold water and left till the cast dissolves and the glove remains. An improvement on this, we have been told of, but have not tried, consists in replacing the sugar by water frozen at 8 to 10 degrees (Centigrade) below freezing-point. A cast in super-frozen ice is thus obtained. It can be quickly plunged into melted paraffin and a very thin glove is once formed before the cast begins to melt and effaces the creases of the skin. The ice can then be left to melt and we can then get a glove as thin as desired.

The ludicrous result that Dr. Geley gets when he makes every effort to duplicate the seance results by use of a water-filled rubber glove

I do not know any other fraudulent procedure. A Belgian engineer lately told me that he had invented a paraffin sufficiently elastic to allow of a living hand being released from it; but I have in vain invited him to give a demonstration of this. It is, however, of no importance, for we can give a conclusive answer to the sceptical. Let us take for granted that it may be possible to make paraffin molds identical with the super-normal ones by using a normal human hand. Could this process have been used by our medium? We call the close attention of readers to what here follows, for it is the point of the whole question:

Supposing the medium to have found out how to make paraffin gloves artificially, he would have been unable to do this during the séance. He must necessarily have made them beforehand and have brought them in surreptitiously. But we are able to certify that the molds were actually made at the séances. We shall now advance the proofs of both these statements.

The molds, under supposition of fraud, were assuredly not made during the séance. The proofs of this are numerous and decisive: The control rendered all complex and delicate movements impossible. The digital imprints of the casts, scrutinized at the Prefecture of Police by M. Bayle, the highly distinguished chief of the Criminal Identification Service, are not the finger-prints of the medium. If it be objected that if not the hand of the medium it must be the hand of one of the experimenters, the answer is that we have frequently had the hands of children, when there was no child present, and no child could have got into the laboratory.

This last argument is decisive. If there be any fraud, the fraudulent molds must necessarily have been brought from outside. *But the molds were not brought from outside. They were made during the séance itself.* In order to have mathematical certainty of this, Professor Richet and I decided on two means of control.

The first consisted in coloring our paraffin immediately before the experiment. Our molds all had the exact coloration of the paraffin so prepared in the laboratory. We also decided to mix with the paraffin some substance soluble in it and admitting of chemical test. Herewith the notes of this crucial experiment made December 31, 1920:

After several trials I chose cholesterin. I poured five grams of it into the warm paraffin. I tested, several times, samples of the treated paraffin, for cholesterin, and saw that the reaction was clear. This chemical reaction is well-known; it consists in dissolving a little of the paraffin in chloroform and adding sulfuric acid. Slowly and gradually a red color, turning to brown, is produced. Ordinary paraffin without cholesterin gives no color when so treated. We had thus a sure method of verifying whether the molds were made during the experiment with our own paraffin. The testimony of our senses was confirmed with mathematical precision.

The manipulations had been made by myself alone before the sitting, in absolute secrecy. The tank of paraffin was placed on the rectangular table about two feet from the medium. Control of the hands of the medium, complete, several times stated aloud. Very dull red light. Soon we heard the splashing in the paraffin and perceived the successive phases of the operation. When I judged this operation finished, I increased the red light, and we could see on the table two molds still warm. One was the foot of a child, admirably sharp in its outlines, and extending up

(*Continued on page 373*)

The Animal Hospital

Surgical Treatment for Horses, Cows, Mules, Dogs, Cats, Goats, Canary Birds and So On

By William A. McGarry

HORSES, cows and mules can now be given surgical treatment for tumors, wounds, laryngitis, ruptures, broken bones, severed tendons, distortions and many internal diseases that formerly made it necessary to shoot them. Such operations are being performed every week day in the year, not only for the purpose of getting information concerning rare diseases that may be of value later in treating human beings, but to save and prolong the lives of the animals and to increase their usefulness. And the same facts apply to dogs, cats and other pets, including rabbits, goats, canary birds, parrots, monkeys and even the pungent skunk. They apply also to barnyard fowl—chickens, geese, ducks and turkeys.

What might be called the other side of the anti-vivisection story was brought to public attention quite recently in Philadelphia by the announcement that there had been set up in the University of Pennsylvania veterinary hospital the first operating table ever built for the accommodation of horses and other large animals. The machine was designed by Dr. John W. Adams, professor of veterinary surgery and obstetrics at the University and chief operating surgeon at the hospital, which is run in conjunction with the school. It was evolved after several years of experience and after all existing apparatus had been found unadaptable to the peculiar needs of the veterinary surgeon.

Testing a horse for tubercular germs through the eye

The table when not in use looks like a section of iron wall backed by leaning braces. It is oblong, and while standing on its side its width is a little more than the height of the tallest horse. At one end there is a projection to serve as a head rest, and the table is fitted with leather pads to prevent galling, and with straps by which the animal to be operated on may be made fast to it. The procedure when an operation is to be performed is quite simple. The animal is walked to a position beside the table, which stands on its side. He is strapped securely to it and a blindfold is placed over his head. One of the surgical assistants turns a lever that sets in operation an hydraulic apparatus, and the table begins to tilt over, carrying the horse along. In a few seconds the animal is on his side, resting comfortably.

Another assistant then goes to work with the anaesthetic, using exactly the same methods as he would on a human being except that the apparatus is larger and specially designed, and more anaesthetic must be used. In operations on human beings it is customary to start with chloroform and then, after the patient has begun to lose consciousness, to use ether. That is done because ether has a sickening effect, although it is not as hard on the heart and therefore not as dangerous. Horses, however, are almost immune to ether. It merely excites them. While it might be possible to render them unconscious by using enough of it, the surgeons prefer chloroform, and a quart of that potent stuff is required as a rule to get a horse ready for the knife.

Total anaesthesia, however, is resorted to only in case of a major operation. When the injury to be treated is local, as in the case of a surface tumor or abscess, procaine, novocaine or some other of the recently developed local anaesthetics are used, and Dobbin never knows that he has been all cut up until long after he has reached his stall, when the effect of the drug is beginning to wear off. When the operation is completed the table is tilted again. In the case of a major operation and total anaesthesia, the apparatus is stopped at an angle of 45 degrees, and a heavy steel hand truck, also designed by Dr. Adams, is run alongside. The straps are removed and it is then possible to slide the horse on the truck, which is wheeled to his stall. By a system of gears the truck is tilted and the animal slides easily to the floor of his stall with minimum disturbance.

Although this table has been in use only a few weeks, it has proved already to be one of the most valuable adjuncts to veterinary surgery. Heretofore all sorts of expedients were used in serious operations on large animals. Sometimes they were performed while the animal, unconscious, lay on the floor. That made it necessary for the surgeon to kneel. At other times hoisting tackle was used to lift the horse to a table. The danger there lay in the injury that might be done to tissues already weakened by the operation, and various forms of hammocks had been devised. The tilting operating table makes all of these unnecessary.

Students at the Veterinary School of the University of Pennsylvania inspecting cows for tubercular germs

Chloroforming a horse preparatory to an operation. It often requires a full quart to put a horse to sleep

Almost at the same time the table was set up for its first use announcement was made in the newspapers of a marvelous operation by a Viennese surgeon, now on his way to Chicago to continue his experiments. He is said to have succeeded in grafting a complete eye from one animal to another in such a manner that it could see just as well as with its own eye. As a rule, however, stories of experiments on living animals hold forth no such immediate and startling hopes as this. Many of the most important tasks of vivisection are for purposes that are never explained to the public, and hence when reference is made to operations on animals it stirs thoughts of supposed cruelty. That is why the University hospital story tells the other side of the anti-vivisection, for its primary purpose is the health and welfare of the animals it treats.

It was more than 100 years ago that the project of establishing a veterinary school and hospital was first broached at the University. In 1807 the noted Dr. Benjamin Rush made an address before the Philadelphia Society for Promoting Agriculture, urging that steps to be taken in that direction, but nothing was done until 1883, when the school was started. For 40 years the school and hospital has been turning out "animal doctors" and saving the lives of burden and pet animals, but it is only in recent years that its surgeons have succeeded in developing a technique in many respects equal to that achieved by surgeons treating human beings. Twenty-two years ago the University, in cooperation with the State, erected a group of sanitary, fire-proof buildings specially equipped for the treatment and care of ailing animals, and these have been added to from time to time until the hospital is perhaps the finest of its kind in the world.

It is only a few years since it was the practice to shoot a horse or valuable cow or bull which had suffered a broken leg, and in many parts of the country that is still being done. The records of the hospital show 11 cases of fracture treated within a year, six of which were successful. The task is far more difficult than in repairing fractures of human bones, since in nearly every case considerable time elapses before the horse gets treatment, and during that period he often splinters the broken ends of bones and irreparably damages the surrounding tissues. Therefore in five cases it was impossible to save the animal. The operative record for the last calendar year, however, is remarkable. In all there were 274 operations performed for a myriad of causes. Out of that number 249 were discharged, eight were sent away as inoperable, two died and 15 were destroyed. The list of large animals included 263 horses, eight mules and three cows.

That, however, fails to measure the extent of the service being given to animals by the hospital. It is the record only of the surgical clinic. In addition there is a medical clinic for large animals which treated 151 cases, out of which 91 were cured and 60 died or were destroyed. In that connection it is of interest to note that the most deadly disease known to horses is comparatively little known to the general public. It is called Azoturia, and may be described as a form of paralysis. According to Dr. Louis A. Klein, Director of the Veterinary School, it kills more large animals than anything else, yet it may be prevented with little difficulty. It is always the result of feeding a horse normal rations while he is standing in his stall for two, three or four days, after a

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Squeezing Softwood to Make It Hardwood

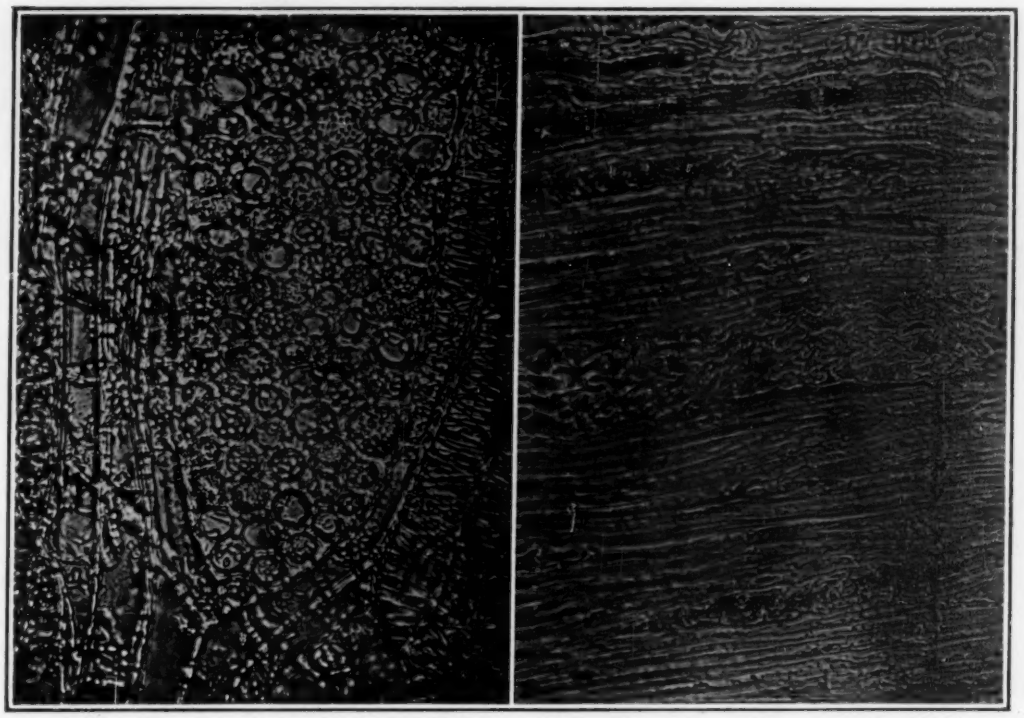
RECENTLY there has been developed in Holland an industry which may bring about enormous alterations in the cultivation of hard woods. It has been possible to convert soft woods, by pressing, into hard woods, which present a very good appearance.

When one looks at a piece of wood in cross section, one finds all kinds of fibers and bundles of fibers enclosing cavities. These cavities are essential for the life of the plant, for they see to the transfer of water and food, as well as to the storage of reserve material. When the plant is dead, however, and the wood is going to be used, then these cavities are an unfavorable circumstance, because they lower the value of the wood. It is then just the quantity of fibers which governs the value. The more cavities there are, with regard to the number of fibers, the softer and more easily split is the wood. It is also a well-known fact that the natural hard woods are characterized by a very small quantity of cavities, compared with the number of fibers. From this it follows directly that as soon as one succeeds in diminishing the amount of cavities in a defined kind of wood, this wood must have better—or harder—properties. Although this idea is self-evident, it has only recently been realized in a technical way.

When a piece of wood is subjected to a uniform high pressure, along with a high temperature, the abovementioned cavities are pressed in and the piece decreases largely in volume. The necessary pressure of about 300 atmospheres must, of course, be applied equally on all sides; and this is best accomplished by using a liquid as the pressure medium. Water is unsuitable, however, for it penetrates into the wood and thereby the pressing effect is lost. A satisfactory medium has been found in asphalt, which only just penetrates into the wood, and then forms such a hard layer, that further penetration is impossible.

A whole tree trunk at one time is placed in an autoclave, dipped under the asphalt, and then subjected at a temperature of 100 deg. C. to a pressure of approximately 300 atmospheres for five hours. The trunk shrinks to about half its original size and greatly increases in hardness. One has to be very attentive and take care that the wood has a definite moisture content, because otherwise cracking takes place. If it is dried too much, the pressed wood begins to swell, as soon as it is brought in contact with moisture. Also, at the high pressure some chemical decomposition reaction takes place, which appears to be necessary for the success of the pressing. With insufficient care a formation of caramel can occur, which causes a darkening in the color.

When the wood is pressed, the outer layer, into which the asphalt has penetrated can be sawn off, and then one can cut it up into whatever pieces of lumber are desired. These pieces possess a very beautiful marking, since the layers, already present in the wood, are now much closer together. It makes a magnificent shining polish. Up to the present, lignostone, as the product is called, has been chiefly fashioned into golf clubs, loom bobbins, walking sticks, and luxury articles, but especially in the domain of inlaid work does it promise a good future.



Cross sections of a piece of elm, showing (left) the wood in its natural state, with large cells, and (right) compressed to make it lignostone, with hard wood characteristics

It is easy to understand that the natural hard woods in the future may experience a strong competition from lignostone.

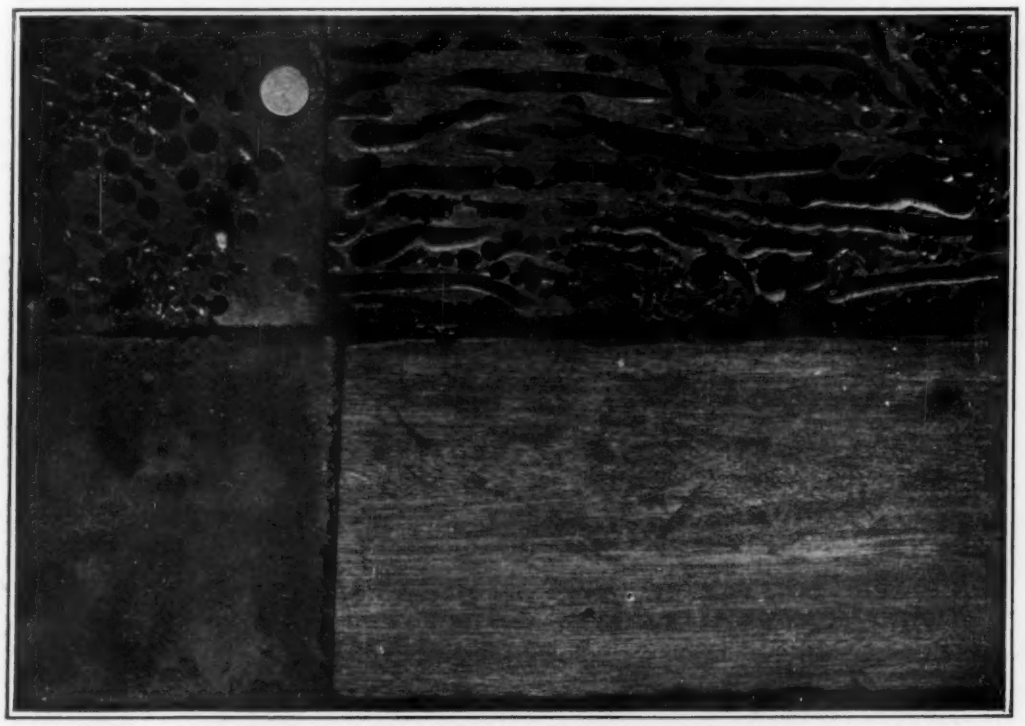
Angelique—A Wood that Resists the Attack of the Teredo

FROM tests recently conducted in Dutch Guiana, it appears that a wood has at last been found which is immune to teredo attack. This wood is Angelique (Dicorynia paraensis Benth), which is said to owe its teredo-resisting qualities to the presence of fine particles of silica in the fibers, which act as an abrasive on the boring apparatus of the mollusk. Physically, Angelique is a dark brown, heavy wood with a specific gravity of 0.851 when freshly cut and 0.746 when thoroughly dry.

Angelique was subjected to rigorous tests in the lock gates of the Saramacca Canal, which lies just south of the city of Paramaribo, the capital of Dutch Guiana. This waterway connects the Surinam and Saramacca Rivers. The water of the canal is brackish and the local government has experienced great difficulty in maintaining the gates and other timber structures because of the presence of the teredo. The gates were originally built of Demerara greenheart, a wood which gained much publicity during the building of the Panama Canal, as it was selected as the best wood known at that time for use in lock gate construction, in waters infested with limnoria. It was not long, however, before it became apparent that greenheart was being rapidly destroyed in the Saramacca Canal, and the Dutch Guiana government undertook to find, if possible, a local timber having durable qualities that would baffle the teredo.

Among the great number of woods experimented with was the native Angelique, which after five years' service in a particularly badly infested locality, was, for all practical purposes, found to be free from attack, while the greenheart placed under the same conditions was utterly destroyed within two years.

Angelique has been used since 1915 in Dutch Guiana by the local railway company to replace imported teak in the building and maintenance of railway cars. When properly dried it answers the purpose exceptionally well, although it has the disadvantage of being harder to work. In all places where toughness and resistance to abrasion are required, it can be safely recommended. Angelique is found in large quantities in the eastern half of the province. Specimens six feet in circumference and 60 feet clear bole are common, while trees as great as nine feet in circumference and having a full ninety feet of bole are not exceptional.



Evidence of the teredo-resisting qualities of Angelique (shown below) compared with greenheart (shown above). Both woods were subjected to five years' immersion in the same locality. The coin is about the size of an American quarter

How to Make Lime Set Quickly

SOME months ago the Bureau of Standards developed a quick-setting lime composed of one volume of ground quicklime and two volumes of hydrate. The commercial success of this material depends upon finding some way to make it keep during shipment, or else to make it into finished form at the factory. Working on this latter phase of the subject the Bureau has been developing a cast lime partition tile. Experiments have shown the best composition to be one volume of wood fiber, five of quicklime and ten of hydrate; and that the best curing condition is outdoors exposed to the weather. Such a block sets so that it can be removed from the mold in ten minutes, can be handled in twenty minutes, can be sawed and nailed, and has a compressive strength of 100 pounds per square inch at seven days. It is about 20 per cent heavier than gypsum tile of the same size, and experiments are now being conducted to see if the core volume can be increased without too great a sacrifice of strength.

The car is placed 25 feet from the test screen that is used to diagnose the ills and evils of headlamps which have gone wrong

Why Headlight Glare?

How Uncle Sam Tested the Headlights on 400 Ordinary Motor Cars and What He Found

By George H. Dacy

ACCORDING to investigations made latterly by national automotive engineers, the automobile headlights on 19 out of 20 motor cars are defective to the extent that they jeopardize the life and limb of other autoists who meet and pass them. Recently, Uncle Sam's official representatives tested out the headlights of 400 automobiles in the District of Columbia—these cars were very typical of the general run of horseless carriages used throughout the entire country—and found that 95 per cent of them were so imperfect in one way or another as to endanger the safety of the operators and other motor car owners who chanced to meet them on the open highway.

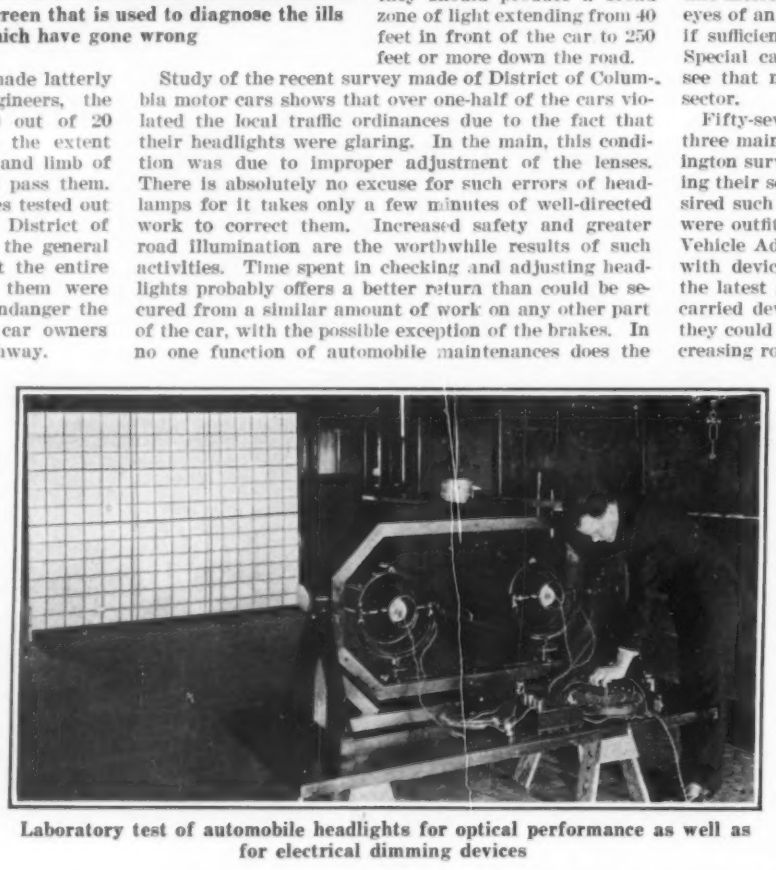
In this day and age when most of the States—where automobile traffic is heaviest—enforce stringent regulations about the design and adjustment of headlights, the fact that in the neighborhood of 19 out of every 20 sets of headlights violate State regulations through the carelessness of the car owners and drivers, is astounding. In the arts and industries, we are constantly reading about the formulation of new safety codes for this or that trade. The resources of science are yoked to the task of taking the doubt and danger out of hazardous occupations. And at the same time, we motorists, as a class, through sheer neglect are promoting a menace in highway travel by forgetting to maintain our automobile lamps in the most serviceable and efficient condition.

The results of the headlight search and research are startling to most of us when we understand that 73.2 per cent of the lamps tested were out of focus. You know how it feels to be driving along a slippery, skiddy pavement some black, rainy night and all of a sudden to have an approaching car almost blind you with its powerful lights whose beams have gone astray due to the neglect of the owner. If the figures are impartially representative—there is every reason to believe that they are—you may expect to be nearly blinded by the unsatisfactory lights of 73.2 out of every 100 motor vehicles that you meet. These facts and figures are astounding enough to keep timid motorists at home stormy nights, when the dangers from improperly adjusted headlights are maximum.

Not only is the man who drives a car with faulty lamps a menace to all those he meets or passes, but he also is a source of danger to himself and the occupants of his car. The lenses of his lamps may be so dirty that they only throw half enough illumination on the roadway—52.8 per cent of the headlights examined were suffering from dirty lenses. As a consequence, the driver may guide his car into the ditch or over a steep embankment just because his lights were so dim that he could not see where he was heading. Of all the cars inspected, 46.7 per cent had headlights that were not correctly tilted; 40 per cent had dirty, rusty or dented reflectors; the lenses in 35.8 per cent of the cars were twisted in the headlamps, while in 23.6 per cent of the cases the headlamps were not parallel.

Dirty lenses and reflectors simply reduce the average efficiency of the headlamps. However, they become dangerous when they do not transmit sufficient light to the roadway to make driving safe. Headlamps that are not parallel are extravagant profligates of light, as rays which should be reflected down the road serve only to illuminate the surrounding scenery. Lack of focus, twisted lenses and lamps tilted upward result in a waste of light and throw a blinding glare in the eyes of the approaching driver. Headlamps that are tilted too far down light the highway for only a short distance in front of the car. They produce a narrow zone of illumination about 80 feet deep extending from 20 to 100 feet ahead of the car, depending on the degree of light. When corrected, they should produce a broad zone of light extending from 40 feet in front of the car to 250 feet or more down the road.

Study of the recent survey made of District of Columbia motor cars shows that over one-half of the cars violated the local traffic ordinances due to the fact that their headlights were glaring. In the main, this condition was due to improper adjustment of the lenses. There is absolutely no excuse for such errors of headlamps for it takes only a few minutes of well-directed work to correct them. Increased safety and greater road illumination are the worthwhile results of such activities. Time spent in checking and adjusting headlights probably offers a better return than could be secured from a similar amount of work on any other part of the car, with the possible exception of the brakes. In no one function of automobile maintenances does the general driving public require direction and education more than in this simple little matter of lamp upkeep.



Laboratory test of automobile headlights for optical performance as well as for electrical dimming devices

The cars were tested for efficiency of illumination by driving them in turn into position about 25 feet from a special screen on which was drawn a horizontal line at the level of the lamp (about 36 inches) and two vertical lines spaced the same distance as the headlamps (about 28 inches). The intersections of these vertical lines with the horizontal lines represented the projection of the centers of the lamps to the screen along a line parallel to the surface on which the car stood. The lamps were focused and the lenses properly pointed so that defects in the position of the lamps could be noted and corrected. When corrected properly, the lamps would throw on the screen oval or elliptical patterns with the long axis horizontal. Light which strikes the horizontal line would never reach a level road. Light falling four inches below this line hits the roadway about 225 feet ahead while rays striking 18 inches below the line illuminate the highway at a distance of 50 feet from the car.

Adequate gutter illumination is secured by light that strikes the screen two feet to the side of the vertical line and nine inches below the horizontal line. In order to obtain some light above the pavement as a protection against overhanging foliage and limbs, the pattern should be so adjusted as to appear slightly above the horizontal line in the center only. A space in the upper left hand sector about five inches above the horizontal and the same distance to the left of the left-hand vertical line intercepts the light which would probably reach the eyes of an approaching driver 100 feet away. This light, if sufficiently intense, is known technically as "glare." Special care must be exercised in adjusting lenses to see that none of the principal beams fall within this sector.

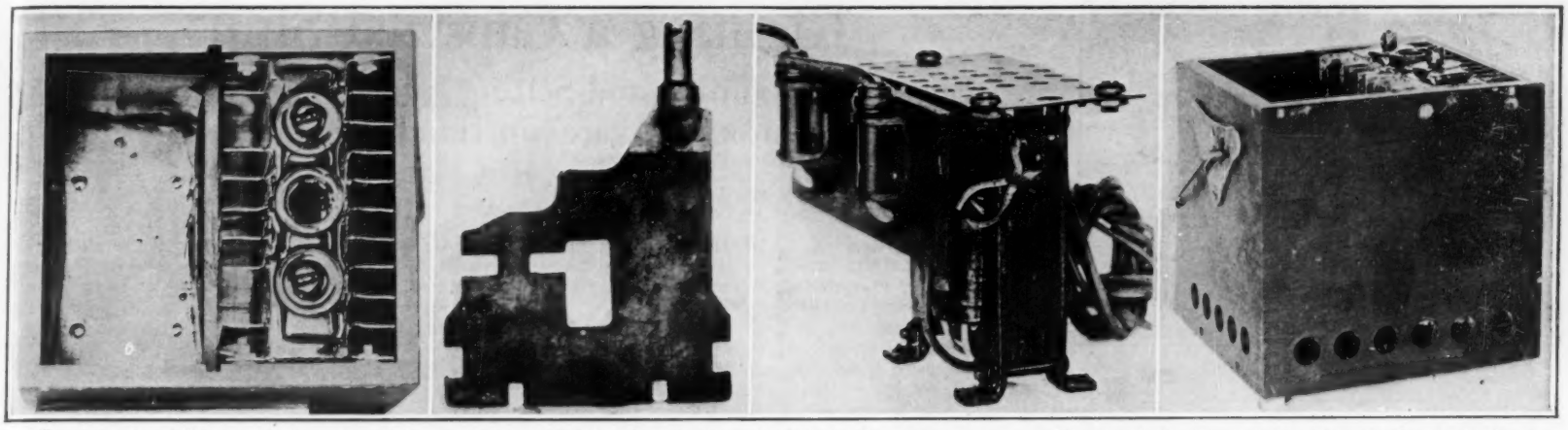
Fifty-seven different makes of headlights divided into three main classes were tested out in the recent Washington survey, the Bureau of Standards experts furnishing their services free of charge to all motorists who desired such assistance. Seventy-two per cent of the cars were outfitted with devices approved by the last Motor Vehicle Administrators Conference; 23.8 were equipped with devices that were of some value but are not on the latest approved lists, while 4.2 per cent of the cars carried devices that were practically worthless because they could not be adjusted to eliminate glare without decreasing road illumination below the limit for safe driving. Despite that good devices were installed on many of the cars, the headlighting was nevertheless defective because only 7 per cent of the best devices were in proper adjustment and over 52 per cent were dangerously glaring. In the second class of devices mentioned above, 55.5 per cent were glaring and only 1 per cent in good adjustment while all the lights in the third class were glaring.

The installation of approved headlight devices on any automobile is merely the initial step in securing safe, legal and adequate road illumination. It is fundamentally important that these contrivances all be maintained in the acme of adjustment if they are to function properly. Frequent and regular inspections are imperative. With the idea of educating the average motorist to the importance of keeping his headlights in proper tune, the Washington Safety Council plans on erecting a number of testing screens in different parts of the City of Chief Executives that will be available to the general motoring public free of charge. Potentially, it is essential that adequate headlight laws be enforced for the protection of the motoring public. At present, so little attention is paid to the proper adjustment of headlamps by the ten million or more motor car owners throughout the country that the traffic courts would be swamped with cases if all the offenders were to be found and fined.

Uncle Sam's representatives believe that future

(*Continued on page 374*)

Another view of the equipment used in testing automobile headlights. Note the swinging support and the clamps for holding different lenses



Components of the new recharger and its complete assembly: First, looking down into the recharger case, with chemical cell at right. Second, the electrode of balkite metal. Third, the transformer and its connections. Fourth, the wooden case, with fins of chemical cell left partly exposed

A Fool-Proof Recharger for Storage Batteries

THERE has lately appeared on the market a new type of storage battery recharger, which now takes its place alongside the vibrating type rectifier and the vacuum tube rectifier, for use in the home and private garage. The latest recharger is a chemical rectifier, complete with step-down transformer and leads, so that it may be readily connected with any 110-volt alternating-current supply.

The action of the latest recharger is dependent on an alloy called "balkite," which is a form of the element tantalum. The material forms a one-way valve when introduced into certain acid or alkaline electrolytes, allowing one-half of the alternating current wave to pass through it, and completely checking the other half of the wave. In the commercial type the standard storage battery electrolyte is used in order to simplify care and maintenance. Furthermore, the recharger contains a two-winding transformer which allows the recharger to be used during the operation of a radio set, without any danger of blowing out vacuum tubes.

The new recharger is of compact dimensions and neat appearance. A sturdy wooden case contains the transformer and the chemical rectifying cell, and provides space for the battery leads and plug connecting cord. The recharger is virtually fool-proof. It is entirely noiseless in operation, while a small red light, which may be viewed through a window in the transformer compartment, indicates when the recharger is working. There is nothing to adjust. It requires no attention except an occasional filling with distilled water. It cannot fail to charge the battery, and it cannot discharge the battery even when left connected. It cannot short circuit. It delivers a taper charge which decreases as the battery becomes charged, so that damage through overcharging is impossible.

The writer of these lines has found the recharger satisfactory in every way, after prolonged tests with six-volt storage batteries used for radio work. The electrical efficiency of the recharger varies between 25 and 40 per cent, depending upon conditions. This efficiency, in view of the simplicity and thorough reliability of the recharger, is ample. Tests on leakage indicate that the recharger may remain attached to the battery without danger of discharging it. The chemical valve will stand a back pressure of 250 volts before it allows current to flow through in the wrong direction.

A leading storage battery manufacturer has recently incorporated this recharger in a compact unit together with a storage battery. Thus in a single wooden case, the radio amateur is ensured a reliable source of filament current or plate current, or both, without the usual multiplicity of apparatus and the bother of connecting up.

Electric Heat for the Type-Metal Pot

IT is well known that all linotypes, intertypes, monotypes and other forms of type-setting and type-casting machines have melting pots in which the type metal is kept molten through the application and maintenance of sufficient heat. However, it is not generally known that the heat must be just so for satisfactory type casting, and that it must be maintained at such critical temperature within very narrow limits.

Gas is ordinarily used for the purpose. Electricity, which has been gaining more and more ground of late years, is considered a decided improvement on gas. On its face it would seem to be the real solution of an even source of heat, but in actuality there are several troublesome factors that insist on popping up. One of these is line-voltage fluctuation, which causes a marked fluctuation in the type-metal temperature and consistency, thus hampering the operation of the type-casting device. The average electrically-heated metal pot requires anywhere from 2,000 to 2,800 watts of energy, which is a strain on the average electric light circuit.

The latest developments in this field take the form of the equipment shown in the accompanying views. A vibration thermometer is incorporated, in which the distance of travel of the pointer has been limited to one-eighth inch. The pointer is held constantly under spring tension against the positive contact. As the heat increases, the pressure against the pointer is built up until the spring tension is overcome and the needle snaps positively from one contact to the other. In cooling, the reverse operation takes place. This positive action insures perfect contact and the sensitivity of the needle is increased the more the machine vibrates. The actual contact end of the needle is a loose roller which must travel around a high point in moving from contact to contact. This automatically turns the roller on the spindle, and presents a cleanly scraped contact surface to each movement. This thermostatic control insures a temperature regulation of 25 degrees on the operating machine, and 30 degrees on the idle machine.

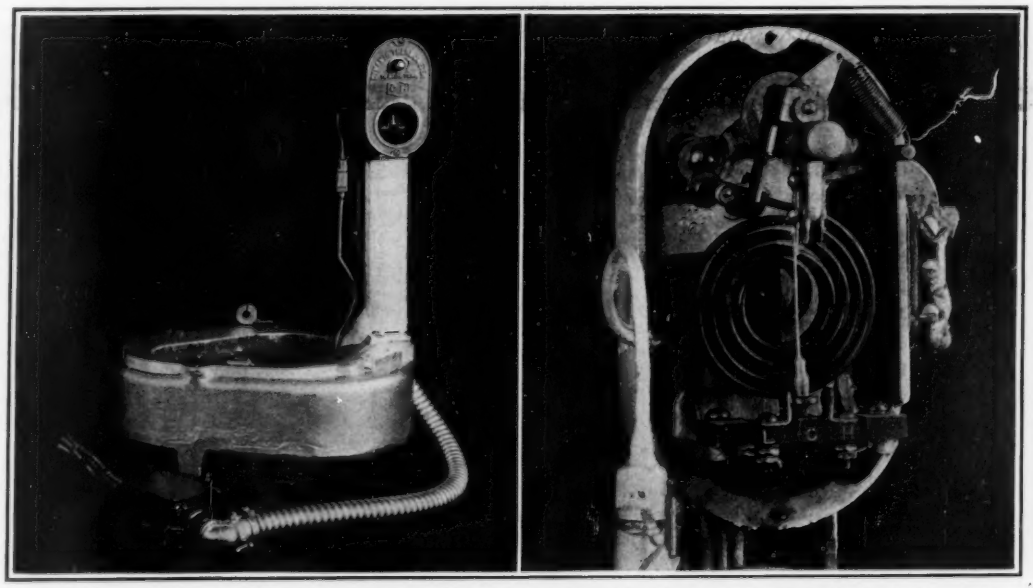
A chemical investigation made at Columbia University proved that there is a critical temperature of type metal. Between the limits of 750 degrees and 1000 degrees F., and increasing directly as the antimony content increases and also increasing directly as the temperature increases, there is a very decided action of the antimony on iron. The affinity of antimony for iron causes great activity of these two metals within these limits. The cleanly finished surface of iron or steel will be attacked at once, and in the case of thin sheeting the walls will be penetrated.

This was exactly the case of the immersed heating unit. The units were made of channel iron and presented an ideal surface for this action. The space between the heaters and the walls of the crucible would gradually become clogged with dross which acts as a heat insulator. The temperature of the metal in this space was naturally higher because the outside heater was also radiating heat in this direction. This natural, excessive temperature was very much increased by the above-mentioned accumulation of the dross insulator, which hampered the conductivity of heat from the unit itself.

The melting point of tin is 446 degrees F., lead 620 degrees, and antimony 1150 degrees. When these metals are mixed, the melting point of antimony is lowered considerably. As the temperature of the metal increases to 800 degrees and above, the tin element as well as the lead element is gradually burned out to a certain extent. As the melting point of antimony is much higher, it is burned out more slowly. The result is that the proportionate percentage of antimony is increased as the percentage of the other elements is decreased. The very high temperature in the space between immersed heaters and crucible walls foster this condition. The increasing percentage of antimony and the excessive local temperature of the mixture set up the most satisfactory conditions for the chemical action of the antimony on the iron channel shell. This shell, therefore, has often been attacked, penetrated, the metal seeped in and the unit was short-circuited.

In the course of scientific research to establish the action of antimony on iron, it was also necessary to find an element which hindered this action. Of all those tried, the most effective and most economical was found to be the scaly surface on iron castings. If this surface was penetrated by filing or machining, the action was the same.

The nichrome wire heaters were inclosed in drawn steel tubes. It was necessary to manufacture these tubular units so that they could be immersed in molten iron at 2300 degrees F., and allowed to remain there until solidification without fear of melting. The danger of explosion, due to moisture within the tube, was also acute. The manufacture of suitable units has now been successfully accomplished and the tubular heaters are covered by not less than one-eighth inch of cast iron. It is impossible for the antimony to penetrate this construction and the heating of the type metal is at its best



Left: **Improved type of electric type metal heater, with vibrating type of thermometer control.** ***Right:*** **Internal details of the vibrating thermometer**

Righting a Capsized Ship

Successful Righting and Setting Afloat of the Brazilian Steamship "Avare" in Hamburg Harbor

By Dr. M. Probst
Marine Engineer

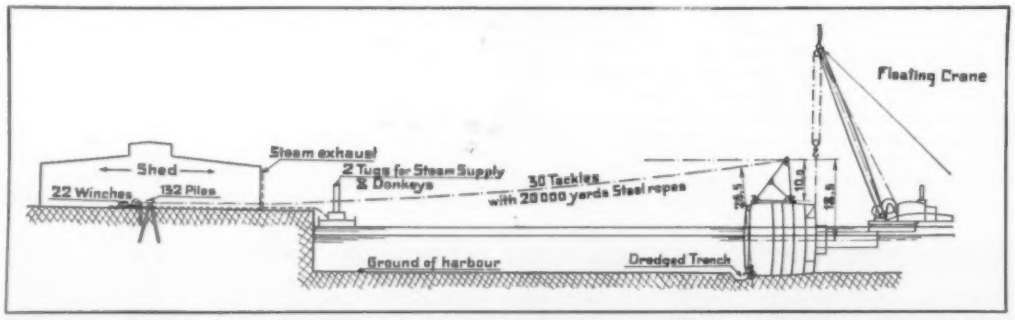
A few of the pulling winches within the pier shed

WHEN the Brazilian passenger steamer "Avare" was leaving the dock last year with double bottom tanks only partially filled, she capsized, for want of sufficient stability, and caused the loss of 39 human lives. In its wrecked position, the ship, which was lying between two piers, was a big obstacle to shipping. A quick salvaging operation, therefore, was demanded in the interests both of the owners and of the Harbor Authorities.

The vessel, with a tonnage of 8227, has a length of 438 feet, a breadth of 56 feet, and a depth of 38 feet. She was formerly owned by the North German Lloyd under the name "Sierra Salvada"; but by the Peace Treaty of Versailles she was transferred to the Brazilian Government. The Vulcan Works of Hamburg undertook the salvaging work, their large shipbuilding yards being situated very near to the place of the accident.

The capsized "Avare," with 12 steel trestles erected upon her side for attachment of the pulling cables

The distance between ship and land being only 300 feet, the salvaging was practically a simple matter, the method adopted having often been practised on smaller boats, with some greater complications also on the German liner "Gneisenau" sunk 1914 and salvaged 1917 in the River Schelde near Antwerp, and on the American passenger ship "St. Paul," which capsized and was salvaged in New York Harbor. This was done by raising about 12 triangular trestles on the port side of the hull, which was strengthened by longitudinal girders. Then these trestles were connected by means of tackles to fixed points on the pier, consisting of driven piles. The tackles were then pulled by steam winches until the ship was righted. After being righted the ship could be ballasted, refloated and towed to the dock.



This shows, left to right, the pulling winches in the pier shed, the cables, the capsized ship with the steel trestles erected on her side, and the floating crane

In spite of the simplicity of this method, extensive preparations were required on the part of the shipyard and her contractors. Trestles 35 feet high were constructed, riveted and erected on board by means of the Vulcan's large floating crane. As the structural material for this work could be taken from the yard's stock, the whole work was finished within a few weeks. All the trestles were connected by horizontals and diagonals, forming a rigid framework.

At the same time large piles were driven into the sand bottom of the quay shed by means of two steam drivers used for building work. Altogether, 132 piles of 35 feet length and 18 inches diameter were required. They were driven in groups of four or six, forming 30 fixed points for the 30 tackles, each of 40 or 60 tons pulling power. The total pulling power was estimated at 1320 tons.

Within the short time at disposal it was rather difficult to assemble the necessary lengths of steel ropes, the whole length of which had to be 20,000 yards. With less difficulty the required steam winches were produced; for on account of the restricted space disposable in the shed no more than 22 winches could be placed there. There were also eight floating winches, each with its own boiler on board. These were moved to the quay below the main tackles.

It was also an important factor to have an adequate supply of steam for the winches on land. Therefore, two large tugs containing 10,500 square feet heating surface were disposed as close as possible to the main winches, and from the tugs steam pipes of six inches diameter, connected by flexible hoses, were conducted to the battery of winches. Similarly, exhaust pipes were arranged parallel to the supply pipes, exhausting out of the shed upwards into the open air.

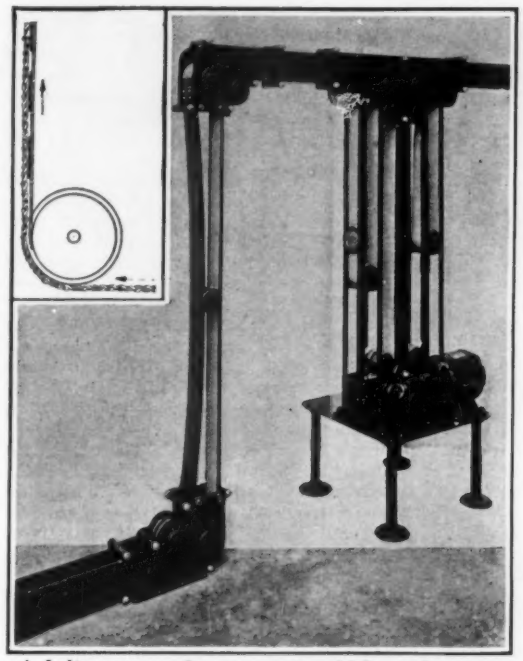
The ship partly righted, ready for the final pumping and floating

In spite of the difficulty of working under water, the holds of the ship below the third deck were made nearly watertight and partially sounded by powerful pumps on board of the salvage barges. The weight to be lifted was by this means reduced. A further diminishing of the required righting moment was gained by dredging a trench below the starboard bilge keel, so that the center of rotation was displaced about seven feet nearer to the center of gravity.

As a considerable reserve of lifting power for the first and hardest period of lifting, four salvage barges and the floating crane of the Vulcan shipyard were moved to the deck side of the capsized vessel. These exerted a lift of 800 tons. The total turning moment, realized with the described means, was 135,000 foot-tons.

Near the middle of August all the preparations were finished, and the navigable water, hitherto used by shipping, was shut off, preparatory to stretching the steel ropes of the tackles between ship and land. The valves on the steam pipes leading from the tugs were opened, the winches tested, and the steel ropes gradually pulled taut. On the morning of August 16 the holds of the ship were drained as much as possible by pumping; the lifting tackles of crane and barges were also pulled taut; and then, on a blast signal, all the barges, donkeys and winches began to pull at full power. In a short time a small lifting of the ship was observed; the winches continued turning; and inch by inch the superstructure was raised out of the water. The turning was continued without interruption until the inclination of the ship was 18 degrees, the hull having been turned through 72 degrees. When this angle was reached the work was stopped, the first stage of salvaging being finished. After being righted the "Avare" was made fully watertight and prepared for pumping out. But the most important point was the stabilization of the ship, to prevent a repetition of the capsizing at the moment when the weight of the hull would be diminished by pumping to the point of flotation. Therefore a large quantity of sand ballast was brought on board and distributed in the holds, with the result that the list of the ship was further decreased. All the water above the sand ballast could now be removed by pumping, at least from the holds, while the engine rooms were left flooded until the other compartments were emptied.

On September 7th this ballasting and pumpwork was finished and ultimately the engine and boiler rooms were pumped out, until the ship began to get afloat. On a displacement of 15,500 tons, with a draft of 30 feet, the "Avare" was towed into the largest floating dock of the Vulcan Works, where the salvaging was successfully finished. All this work was done in ten weeks, at a cost of no more than 7½ per cent of the initial cost of the ship.



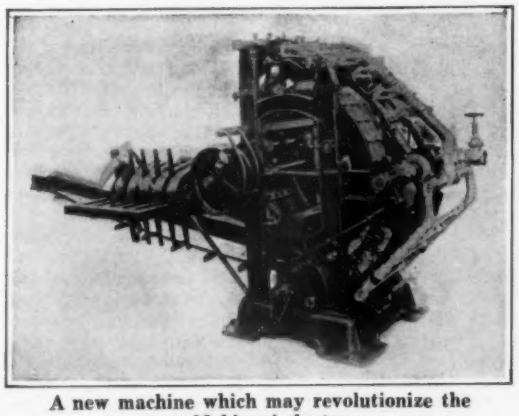
A belt-conveyor for messages which works on a novel principle

Something Different in Belt Conveyors

OF decidedly unusual design is the belt conveyor recently installed in the Berlin trunk-line telephone exchange. It takes the place of the flat-tube pneumatic mail installations formerly in use for the transmission of order slips. The new belt conveyor comprises a belt passing along the trunk-line record tables and is based on the fact that the friction coefficient of paper on metal is only half as much as that of paper on textile fabric. The order bulletin is slipped between the traveling belt and a plate of sheet metal serving to guide it and, on account of the greater friction, adheres to and moves along with the belt. Inasmuch as the same scheme would seem to lend itself to many other applications in connection with the conveyance of large quantities of letters, slips and other light objects, it is of more than passing interest.

The essential idea of the new belt conveyor is made clear by the drawing which shows the woven belt, the sheet metal guide, the letters or slips of paper, and a pulley. Part of a typical installation is shown with ups and downs and sharp curves to demonstrate the flexibility of the system, as well as the electric motor drive. It will be understood that the belt does not have to be continuous. An ingenious mechanical arrangement permits of transferring messages or letters from one belt to another, and there is even a possibility of guiding the traffic through angles of less or more than 90 degrees by providing an auxiliary pulley which, by means of sheet metal plates, connects the two belt sections. In the case of paper slips of constant size, the belt should preferably be adapted to the width of the paper. The paper slips or other light objects conveyed by the belt are, at the opposite end, discharged over a pulley into a hopper.

This ingenious German system has some advantages over the usual message-conveying systems now in use. Its simplicity and low cost are, of course, the main advantages, while the ease with which it turns corners and climbs up or goes down makes it more flexible than a plain belt conveyor found in some telegraph offices.



A new machine which may revolutionize the codfishing industry

The World's Largest Gasket

A CHICAGO manufacturer of gaskets has, it is claimed, made a larger gasket than any in the world, and as this concern is the largest gasket manufacturer in the world such a consummation is quite fitting. Measuring 10 feet 9¾ inches in diameter on the inside and a full 11 feet in its greatest diameter this mammoth gasket required, in order that it might to best advantage be posed for a photograph, the support of three men, one standing well up on a lofty step-ladder, two mounted on high office stools. Such a gasket must be handled with care and if shipped without dissection or bending would require a good bit of a freight car.

Directive Radio Transmission on a Wave-Length of 10 Meters

UNTIL recently radio communication was for the most part carried on from a transmitting station to one receiving station; that is, it was "point-to-point" communication. There were only a few special kinds of service, such as time and weather signals, which were transmitted from a sending station to any considerable number of receiving stations. However, even in the case of "point-to-point" communication, radio signals were sent out in every direction and could, if desired, be received by any station within a certain distance regardless of its position with respect to the transmitting station. Since the total number of messages sent was small, a comparatively small number of wave lengths was sufficient to take care of traffic requirements. With the development of radiotelephone transmitting apparatus, the broadcasting of voice or music by radio has assumed an important position, and the waves used in this work occupy a wider band of wave lengths than the sharp waves used for radio telegraph signals. With the greatly increased traffic and the much wider band of wave lengths which it occupies, considerable interference has developed among broadcasting stations and between broadcasting stations and radiotelegraph stations.

There are two ways of reducing such interference: To direct the waves from the transmitting station in a narrow beam toward the receiving station and to employ in such transmission shorter wave lengths than have heretofore been used. In England investigations have been made of directive short wave transmission and at the Bureau of Standards experiments have been conducted on transmitting apparatus employing electron tubes which transmits a directed beam of radio waves and employs waves as short as 10 meters. In these experiments a reflector has been used consisting of short, parallel, vertical wires arranged on a frame shaped like a parabola or reflector functioning in much the same way as the mirror for light waves. Forty vertical wires were used and the generating set with its small antenna was placed in the focus of the parabola, each wire was tuned separately to 10 meters by adjusting its length, and it was found that about 75 per cent of the radiated energy could be confined within an angle of approximately 75 degrees.

This apparatus is described in Scientific Paper of the Bureau of Standards No. 467 and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.

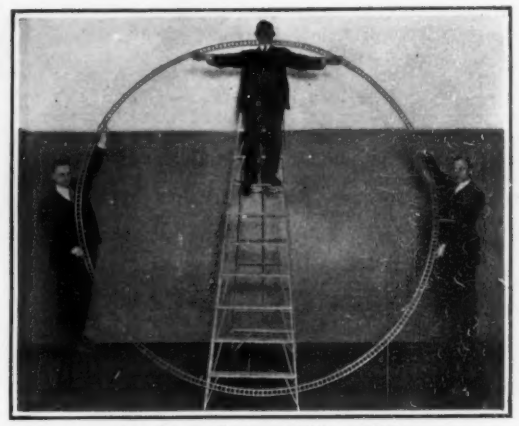
Fatigue Tests of Limestone

AS noted last month, the Bureau of Standards is carrying out a series of tests to determine to what extent stone will fatigue under a continuous load. The specimens are prepared in the form of beams which are supported at the ends and have a load suspended from the center which is calculated to give a stress in the stone equivalent to two-thirds of the ultimate strength. Deflection measurements are being made at intervals to determine if there is a continuous sagging, which, apparently, is the case according to measurements which have been made to date.

Dressing a Codfish Every Second

OUT on the foggy Grand Banks the most arduous task of the cod fisherman is "dressing down." Everyone dreads it, for it means working regardless of hours until the job is done. If the catch has been heavy, midnight, or even the dawn following, sees the entire crew hard at it by the light of flares. No one, not even the cook, commonly known while afloat as "the Doctor," may have any respite. The deck is slippery with parts of the thousands of cod that have been slid from the knife of the slitters into the hold. Cut fingers are of no avail as an excuse for laying off.

Power has taken a lot of the meanness out of life at sea and the same little gasoline engine that hoists the sails and weighs the anchor will now have more to do—and the crew, less. The "Iron Splitter" does the work

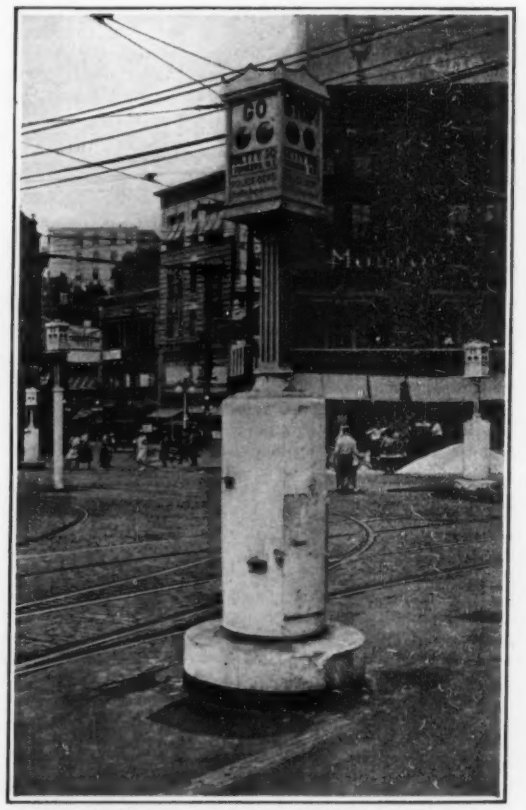


An eleven-foot metallic gasket

of 60 to 75 men who now wield sharp knives on the Grand Banks off Newfoundland, up along the Labrador, as well as in the localities frequented by fishermen from France, England and Scandinavia. Every second the new machine takes a fresh codfish and as often it turns out a dressed fish. It performs all the usual operations of splitting, removing the backbones, cleaning and washing. This ingenious machine was perfected in Seattle, Washington, by the company which perfected, in 1905, a somewhat similar machine called by fishermen "The Iron Chink" because it took the place of thousands of Chinese who were formerly employed to clean fish in the salmon canneries of the North Pacific.

More "Talking Lamps"

MOTORISTS who pass through Yonkers, N. Y., at night will find a device installed at the intersection of five principal streets which not only enables one policeman to control the heavy motor and street car traffic at a congested point but controls it better than several officers who were formerly stationed at this intersection were able to do. In the photograph, the three beacons nearest the camera revolve while the one furthest away is stationary. Beside the latter stands the single traffic officer whose duty it is to control the entire group of beacons. By pushing a button on the side of the distant beacon he simultaneously revolves the other three beacons, each of which bears the usual "Go" and "Stop" as well as the corresponding green and red lights for night signaling. In addition to these signals there is a gong in each beacon which automatically rings as the top turns, thus giving an audible as well as a visible signal.



A remarkable group of four traffic beacons which is controlled by a single officer

Improving Irish Linen

SINCE almost a century the world has been dependent upon Russia for the flax from which it makes linen. A minor portion has, however, come from Belgium, Holland, France and Ireland. Americans, mostly unaccustomed to observing the culture of flax, and therefore unfamiliar with the great source of this valuable fiber naturally associate flax with Ireland, for Irish linen figures in literature, and the words "genuine Irish linen," when applied to tablecloths and napkins connote high quality.

Ireland is trying to improve the quality of her linen still further by improving the flax plant from which it is obtained. This is quite the opposite of the trend of flax quality in Russia, the giant of the flax industry, at least in quantity of production. For Russia's flax has deteriorated. Russia was satisfied. Peasant labor was cheap and there was plenty of it. And was abundant—one thinks of Russia as a vast expanse of land, the cities only secondary. Ireland was put to it to compete, for land in Ireland is scarce. There a nobleman's estate, kept primarily for hunting during a few weeks of the year, might monopolize as much land as a hundred peasants would need in order to support themselves in simple comfort by raising flax. Even barren, rocky hillsides have been literally carpeted with a layer of land laboriously lugged up the slopes in baskets on the backs of patient peasants. How could Ireland, thus handicapped, compete with boundless Russia? By raising not more, but better, flax.

And so, while the Russian neglects the evolution of new strains of flax fiber the Irishman organizes the Irish Linen Research Institute at Belfast. Even before the Great War, during a decade the Russian yield had been dwindling, yet so great was the remaining total production there that flax could actually be sold to the Irish linen manufacturers at about $175 per ton. Is it, then, a wonder that the rent-racked Irish farmers, facing such competition, gradually gave up growing the crop? Instead of 100,000 acres their acreage has fallen to 30,000.

Today, of course, Russia exports but a fifth of her hundred thousand tons of flax to Ireland of the pre-war days. By this lopping off of the Russian supply the price has been boosted to about $250 per ton.

How, then, to make flax growing profitable to the Irish farmers, and thus to encourage its production by them, is the problem which the Irish Linen Research Institute is tackling. At the outset, two main remedies suggest themselves—improving the yield of flax per acre and improving the quality of the fiber for spinning.

In order to increase the yield per acre efforts are being made to grow more flax plants per acre, to increase the size of the individual flax plants and to increase the proportion of available fiber in the plant itself.

One apparently simple way to grow more plants per acre is to sow more seed. Nature rebels—the plants resulting are spindling. Therefore Mr. Searle, the research botanist of the Institute, concludes that the result must be accomplished by breeding taller plants. Simultaneously the plant breeder will work for a larger proportion of spinnable fiber per stem.

If genius is the art of taking pains the work done at the Research Institute is genius spelt in capitals. Early in the month of May six to eight thousand seeds are put down, each carefully planted singly and on six-inch centers, each way. When the stems reach a length of nine inches each is tied up to a cane. Later, when the flower appears each single plant is examined, its blossom is removed, and in order to prevent cross-pollination an oiled paper bag is placed over it. Thirty-five days later the plants are pulled.

Now the plants are studied and records are compiled from measurements of the length of the stem, the length of the unbranched part of the stem, its diameter, and the extent to which it has side branches. Portions of every one of the stems are imbedded in wax and 120 cross-sections are cut from each portion. These are magnified 5000 times and the area of the individual fibers is estimated by the planimeter. The number of individual fibers in each bunch is counted. From these and other data what is called the "coefficient of correlation" for each plant is found. This gives an index of the chance of securing an improvement in the strain by breeding this plant with others.

So far the work has been successful. There has been evolved the "John W. Stewart" pedigree flax which yields 100 per cent more than that grown from commercial seed. This is true both of quantity of yield and quality of the fiber. Instead of about 350 pounds of flax per acre, the farmer will have, with the same cost of production, over 700 pounds. Applied to Ireland's last season's flax crop this would represent an increased return of about $3,500,000. Furthermore, the spinners and the weavers are delighted by the immensely better quality and quantity available for making linen.

Better flax, together with better methods of retting, are bound to bring up the volume of the Irish linen industry.

When Our Teeth are Out of Gear

PYORRHEA is the most talked about dental disease. The older people have it and the younger folks are afraid they will get it. Although the term pyorrhea alveolaris is a misnomer, yet so many people are acquainted with the nomenclature, that in order to avoid confusion it will be allowed to remain in this article.

Contrary to general opinion, pyorrhea is not inherited. We inherit types and forms of teeth, and types and forms of jaws. We might also inherit the manner in which teeth are so set in the bones as to be conducive to the formation of a periodontal lesion. The cause is local to every affected region. About 90 per cent of the cases of pyorrhea result from traumatic injury. This injury results from the packing of food between the teeth, from the lack of proper mouth sanitation, from injury to the tissues by the use of tooth picks, and from injury because of traumatic occlusion of the teeth.

Traumatic injury which results from the packing of food between the teeth is due partly to negligence on the part of the patient in not having proper dental operations made to preclude the food from leaking or packing between the teeth, and partly to oversight on the part of the dental operator in not making fillings which will prohibit such injury. This sort of injury, coupled with lack of dental cleanliness, argues well for a speedy loss of the teeth from a pyorrheal invasion.

When the patient's attention is directed to the injury received by the vicious tooth pick habit, that habit is generally corrected.

One can unseat a nail driven into a board, or a post driven into the ground, by striking either near the top or from side to side. This misapplied force is what also happens to the teeth when traumatic occlusion is continued for an indefinite time. The teeth are literally chewed out of their sockets.

The teeth may not erupt in a harmonious occlusion. A slight irregularity might throw the entire occlusal plane out of a normal occlusion.

The most potent factor in the production of a periodontal complication is the occlusal wears of the teeth. The occlusal surfaces of the teeth wear into odd and peculiar shapes during mastication. Sometimes grinding the teeth during sleep has an untoward influence upon their surrounding tissues. When this wear continues for an indefinite time, the teeth are worn into grooves and high points. When these irregular occlusal wears have taken place, a greater mechanical leverage is then obtained outside the jaw, and the teeth are easily forced from one side of their sockets to the other. This tooth movement breaks down the bone surrounding the roots of the teeth receiving the uneven stress. The great force and shock incident to the rubbing or grinding the teeth together causes a traumatic injury to the membranes surrounding the roots of the teeth which results in their absorption, and finally in a loss of the teeth.

Frequently a case of pyorrhea is oberved in a patient who has no cavities and few or no fillings. An X-ray examination, however, discloses the fact that an absorption of bone has taken place to such an extent that treatment will be productive of no good or lasting result. The patient in most cases does not recognize that such a bad condition is present until the teeth are loose. It is almost too late then to begin treatment. This destruction of bone surrounding the teeth is caused by a traumatic occlusion.

After the X-ray examination has disclosed the true condition of the mouth, the operator decides what teeth, if any, should be extracted. After extraction he proceeds skillfully to reshape all the remaining teeth. The high irregular points on the occlusal surfaces of the teeth should be ground or polished off, the operator simultaneously widening the narrow constricted fissures until there is a free easy condyle movement during mastication. The teeth must mesh correctly. The teeth must be reshaped until there is a harmonious contact of the teeth of the one jaw with the teeth of the opposing jaw; that is, they must mesh properly as in the case of gears.

The reshaping of the teeth, together with the obliteration of pus pockets, coupled with oral cleanliness, will generally subdue most pyorrheal lesions, provided treatment has been instituted early enough.

Investigation of Orifice Gas Meters

FOR several months the Bureau of Standards has had under way the preliminary arrangements for an investigation of the performance of orifice meters. Certain special equipment, such as large sized air compressors, cooling coils, receivers, test lines (made of extra heavy piping), besides indicating instruments are necessary to carry out work of this character, and it has been largely because of the excellent facilities offered to the Bureau of Standards by the War Department at Edgewood Arsenal, Edgewood, Maryland, that the taking up of this investigation has been possible. The present investigation has been limited to a study of the orifice meter of the type used in the commercial measuring of gas. The principal problem of the investigation is to determine the discharge coefficient under all the variable circumstances which may occur within the range of commercial or engineering practice.

In order to solve this problem it will be necessary to make a careful study of the effect of the following variables upon the discharge coefficient: (1) The shape of the orifice, which may vary from a sharp-edge hole in a thin diaphragm to a long flow nozzle; (2) the diameters of the pipe and orifice, *i.e.*, the size and area ratio of the orifice; (3) the location, size, and finish of the pressure taps; (4) the length of straight pipe on each side of the orifice or the nature of the fitting or obstructions near the orifice; (5) the linear speed through the orifice or the rate of flow; (6) the absolute pressure in the line and the magnitude of the differential; (7) the density, viscosity, and specific heat ratio of the gas and its deviation from Boyle's law; and (8) steadiness or pulsation of the flow.

The set-up as now arranged will permit the study with air of points Nos. 1 to 6, as enumerated above, through a wide range of conditions. It may be possible to give special attention to item No. 8. It is hoped that when this work is completed it will be possible to make experiments using natural gas or other gases for the investigation of point No. 7.

Up to the present time only a few preliminary runs have been made. During these runs approximate checks were made of the discharge coefficient of the flow nozzles which are to be used in the final measurements. These runs have also served to bring out defects in the equipment and have thus furnished a basis for making alterations and improvements.

A Versatile Motorcraft

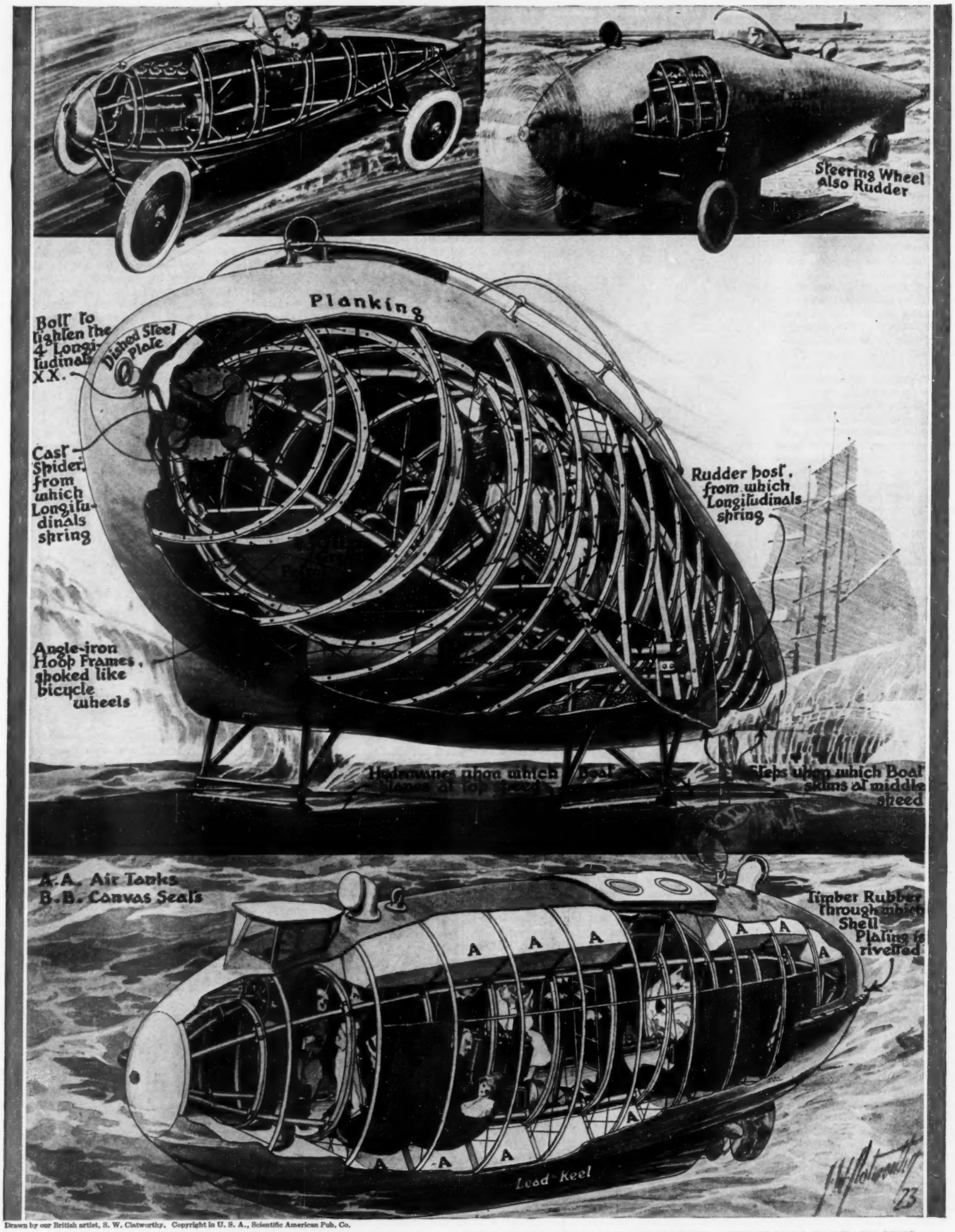
PROBABLY the most interesting object seen by the delegation of American foundrymen during their visit to the Shipping, Engineering and Machinery Exhibition in London last September is a remarkable new speed boat designed by Mr. Green of aero engine fame. This peculiar craft goes one better than the skimming boat in that it rises completely from the water, thus eliminating the skin friction occasioned by planing upon hydroplanes which are almost at the surface. When the speed reaches 70 knots only the propeller and the tip of the rudder remain immersed in the water.

The construction of this hybrid craft is revolutionary, combining great strength with extreme lightness, and somewhat resembling airplane work. Around a skeleton consisting of four tubes extending from end to end is placed a series of hoops made from angle iron curved in a tire-bending machine. In place of the customary rib frames the hoops are held together by spokes similar to those of bicycle wheels.

On the facing page are shown two modifications of the same fundamental structure. At the left is a racing motor car in which body and chassis are one. The design lends itself to fine streamlining. At the right is, not a new one-man submarine, but an amphibian with airscrew drive, shown in the act of leaving the water.

At the bottom is a ship's lifeboat capable of being launched, with hatch closed, in any position. Canvas seats are snugly fitted between the hoop frames.

The large hull shown in the center picture was tested, after completion, by supporting it solely at the extremities. The actual deflexion at the center of her 40-foot length was found to be but one-eighth of an inch. Each spoke of the hoops has right-angled heads fitted into key-hole slots and divided and joined at the center by a sleeve turning on right and left handed threads on the respective sections of the spoke. Thus, by attaching to the screwbolts at nose and stern the entire structures can be braced and made a unit.


Steering Wheel also Rudder
Planking
Bolt to tighten the 4 Longitudinals XX.
Dished Steel Plate
Cast Spider from which Longitudinals spring
Rudder post, from which Longitudinals spring
Angle-iron Hoop Frames, spoked like bicycle wheels
Helmsmans upon which Boat planes at top speed
Skeps upon which Boat skims at middle speed
A.A. Air Tanks
B.B. Canvas Seals
Timber Rubber through which Shell Plating is rivetted
Lead Keel
A
B
23

Drawn by our British artist, S. W. Clatworthy. Copyright in U. S. A., Scientific American Pub. Co.

QUEER STREAM-LINED CRAFT THAT MAY BE USED AS A HYDRO-PLANE, RACING AUTOMOBILE, AMPHIBIOUS BOAT, OR NON-SINKABLE LIFEBOAT.—(See facing page for description)

With the Men Who Fly—II

How the Glider Flights of German Students Have Brought About a New Era in Aeronautics

By Alexander Klemin

Lecturer on Aeronautics, New York University

DURING the war, in the desperate struggle for air supremacy, the most direct method of beating the enemy was to have more speed and climb secured by the use of greater and greater engine power; in other words, by brute force. This tendency persisted for several years after the end of the war. It is true that there has been improvement in wing sections, in the aerodynamic cleaning-up of wing trusses, in the careful fairing of bodies and projecting parts, in the introduction of wing radiators which do away with the resistance of the ordinary automobile type radiator. But enormously high-powered machines are still used, a single-seater fighter being commonly equipped with 300 to 400 horsepower. This tendency unavoidably reacts on the design of commercial planes, with high power and large gasoline consumption, retarding commercially the profitable application of aircraft.

IN the October issue Mr. Alexander Klemin gave us a broad survey of the coast-to-coast flights and their lesson, the extraordinary advances in engine design, and the steady progress toward night flying, all of which comprised the first article of this series. In the present article Mr. Klemin, who is a recognized authority in the broad field of aeronautics, reviews the progress in gliding flight and speculates on its importance in airplane design. This article was to conclude the series, but so great has been the activity in aeronautics during the past month or two, that we have asked Mr. Klemin to write a third article which, unless aeronautical progress keeps up at its present brisk pace, will complete his review of recent events and their significance.—THE EDITOR.

Aviation History Repeats Itself—Gliding Flights

But while the United States, Britain and France continued in peacetime to develop their airplanes in the same direction, the Germans, forbidden by the International Allied Commission of Control to build high-powered planes, made an extensive study of the more subtle art of gliding. This enforced specialization may be a tremendous boon for aviation, as it may pave the way for low-powered planes and mark a new era in airplane construction.

Often hampered by lack of funds, working under extreme difficulties, German builders had the advantage of cooperation by their universities, and rapidly developed both wonderful machines and skilled glider pilots. German pilots achieved a truly remarkable control over their machines, actually describing figure "S" flights and other evolutions in motorless flight, and for a long time the German pilot Hentzen held the world's duration record for gliding of 3 hours 6 minutes, until this was beaten by the Frenchman Maneyrol at the Lewes meet in England, October 21, 1922, when he remained aloft for 3 hours 37 minutes. Since then the former allies have kept the lead and the world's duration record is at present held by the famous French pilot, Georges Barbot, who at a meet at Biskra, Algiers, stayed aloft for 8 hours 5 minutes. Among other interesting achievements Fokker, the famous Dutch designer, has kept aloft for 13 minutes, carrying a passenger, and an English pilot, G. R. Olley, soared with a passenger for 49 minutes at the same Lewes meet. In the United States, Glenn H. Curtiss, one of the early pioneers of the airplane, built a miniature flying boat with which he has achieved a number of short glides, when released from the towing rope of a fast motor boat. It is ultimately hoped to develop this form of gliding to the point where the crest of a wave may be a sufficient eminence for the start of a glide. At present, being towed behind a motor boat and cutting loose provides a thrilling sport with very little danger.

The question naturally arises whether these remarkable duration flights are a mystery; whether we are approaching the soaring power of birds and shall ultimately be able to fly from point to point at will without the use of power. The answer is that there is no particular mystery about gliding; that it follows the ordinary laws of aerodynamics; that duration gliding is a question of good meterological conditions and a good machine suitably controlled. While under perfect conditions duration gliding is limited only by the physical endurance of the pilot, gliding from point to point at will is not yet in sight, although it is theoretically possible by utilizing the internal energy of the wind.

The principles of gliding are fairly simple. In still air, the glider must have a certain forward velocity so that the wings give the necessary sustention or lift. In achieving this forward velocity the resistance of the air acts on the wings and the rest of the glider, and absorbs energy. This energy is supplied by gravity. In other words, the glider must lose altitude to sustain its gliding flight, and flight is not horizontal as in the case of a machine where resistance is overcome by the power of the motor acting through the propeller, but on a downwardly inclined path. In a good glider the resistance of the wings and of the rest of the machine is reduced to the minimum, the least possible energy is lost and the glide is a gentle one. In the first gliders such as those used by the Wrights the glide path was one in five or six. In the best German gliders the glide path is one in sixteen, or, in other words, in a glide of 16 feet only one foot altitude is lost. This shows what tremendous progress has been achieved in diminishing the resistance of gliders, and also of airplanes, which are nothing but powered gliders from one point of view.

But this is speaking of gliding downwards and does not explain how flight is maintained indefinitely. However good the glide path, the machine will ultimately reach the ground, unless there is *a rising current of air*. The rising current of air supplies the energy which must otherwise be obtained from the action of gravity by losing altitude.

The skill of the glider pilot is in finding a terrain where there is an upward current of air to supply this energy. When the rising current fails, the aerodynamically clean machine loses little altitude, and the pilot, by a species of flare, so maneuvers his machine that he promptly finds the rising current which may sustain him or even give him greater altitude. And we see that skilled pilots on modern gliders seem to be able to sustain themselves indefinitely in this manner. Gliding is not dissimilar from sailing, where great skill must be used to utilize favorable winds.

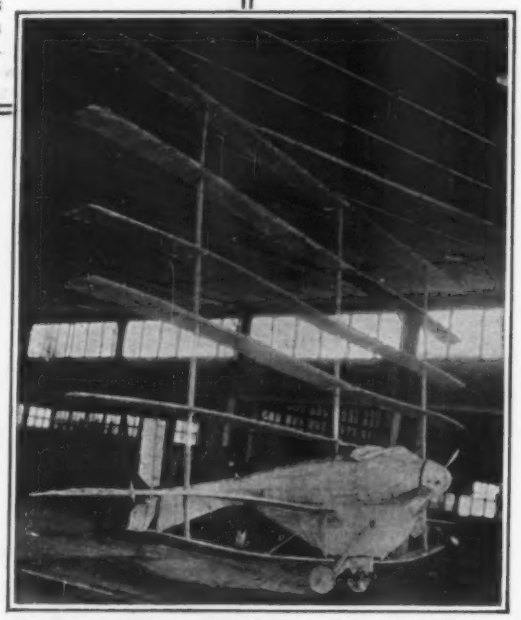
But if the glider is no mystery, if duration flight only and not flight from point to point has thus far been achieved—if at present it is but a fascinating sport, gliding flight has great usefulness in both scientific and practical aviation.

In the construction and design of experimental airplanes, the glider may serve as a most useful adjunct. It is extremely expensive and disappointing to build a large airplane and find its aerodynamic efficiency or control to be poor. The glider may furnish a ready and cheap method of experimentation with lessons directly applicable to the powered machine. Efficiency, stability and control may all be studied out cheaply and quickly in this manner.

What Aviation Learns Through Gliding Flights

But besides being a possible adjunct to the testing of experimental airplanes, the glider *per se* will forward the aerodynamic efficiency of airplanes in general. The efficiency of an airplane is inversely proportional to the gliding angle or inclination of the glide path. In other words, the more gentle the glide path of an airplane, the less the power required to pull it through the air. Gliding paths of commercial airplanes as at present designed are seldom better than one in eight. And the result is that about 60 horsepower is required to carry an airplane passenger on a three-hour journey at a speed of 100 miles per hour. Under the pressure of necessity, builders of gliders have improved the glide path up to a value of one in sixteen, as in the German "Hanover" glider. There is no reason why the same increase in efficiency should not be attained in the construction of full-sized machines with corresponding improvement in the economy of airplane transportation. Gliders must also be light, as otherwise they might have good glide paths and yet have a high rate of downward velocity in still air; and also because a heavy glider is more difficult to launch. Builders of gliders have accordingly learned to build light, while maintaining a reasonable factor of safety, and the structural lessons learned thereby may also be translated into airplane practice. The glider, moreover, is a splendid and inexpensive school for pilots, and a safe method of weeding out men who should never be pilots.

But the greatest immediate value of the glider work is in the impetus it has given to the construction of low-powered airplanes and incidentally to the small air-cooled two- or three-cylinder motor of a few horsepower that goes with them, such as the German Stax three-cylinder rotary motor which weighs only 17.5 pounds complete and yet develops 7.5 horsepower.



Cycleplane successfully flown at McCook Field, by foot power. *Above:* One of the aviation routing beacons for night flying

The Advent of the Low-Power Plane

It is really remarkable what can be achieved with the use of small power. The German Budig motorized glider, equipped with a tiny four-horsepower motor, can rise from any ground, independent of the direction of the wind, and sustain flight indefinitely. Georges Barbot, holder of the glider duration record, flying in a Dewoitine monoplane of seven horsepower, made an official maximum speed of 56 miles per hour; furthermore, his plane can reach an altitude of 9500 feet and travel 600 miles on a gallon of gas. The most striking achievement of the motorized glider is the crossing of the English Channel by Barbot with a 15-horsepower motor installed in the same Dewoitine mono-

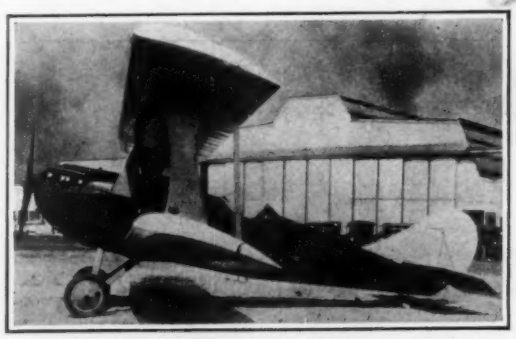
plane. Carrying only one gallon of gas, Barbot flew from St. Inglevert, France, to Lympne, England, in 61 minutes, and returned in 44 minutes, winning a prize of 25,000 francs for the trip. Flying the same plane in the United States, Barbot created a wonderful impression of maneuverability and economy, but crashed in a stormy trip from Long Island to Washington. Perhaps difficulty in meeting very gusty air is the one big problem to be solved in the construction of low-powered planes. But in spite of this inauspicious accident, there is no doubt that the low-powered airplane is a very promising field of development, that it will be a remarkably cheap method of transportation and that the "air flivver" will soon be within the reach of every adventurous young man.

Apart from its value in technical progress, gliding is a fascinating sport. A certain amount of interest has been aroused in this latest sport in the United States, and amateurs are building and gliding all over the country.

It is also highly interesting to consider how far it is possible for amateurs to undertake glider construction and operation, and what value such work may have in furthering aviation, besides the fun of the game and the possibility of winning prizes at a meet.

It is a well-known fact that radical discoveries and achievements have very often come from men not at all deeply versed in science or engineering. The airplane owes its birth to the Wright brothers, who were not primarily engineers, although they developed the airplane in the most scientific manner possible. It is possible that equally gifted, though now unknown amateurs may seize on the opportunities afforded by glider experimentation, and help in the scientific development of aircraft by bringing fresh and ingenious minds to bear on its problems.

Before undertaking this stimulating and useful form of activity a number of considerations have to be taken into account. A suitable terrain is essential. The National Aeronautic Association in seeking the ideal terrain, apparently found near Oakland, stated its requirements to be a long ridge rather than a hill, with a total drop of at least 1000 feet, a slope of one in four at the top of the ridge and one in eight further down, freedom from trees and obstructions, and steady wind velocities of 15 to 20 miles an hour. These requirements do not include the fact that there must be some measure of upward current. A glider will not stay up indefinitely in any horizontal wind however violent, unless there is an upward current, at least an intermittent upward current, as we have shown earlier in the article.



Glenn L. Martin plane designed for use in night flights by air mail pilots

Piloting the Glider

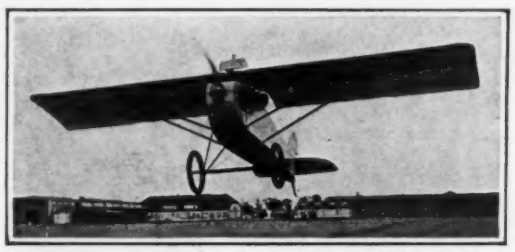
While glider piloting is reasonably safe, the amateur must not underrate its difficulties. Gliding is in some respects more difficult than piloting a powered airplane. It is more delicate, more instinctive, less susceptible to rules and systematic instruction. If the glider pilot wishes to make duration glides, he must take advantage of every favorable gust, and use aerodynamic principles subconsciously. He must appreciate meteorological conditions and adapt himself instantaneously to every variation. Patience and long experience are necessary to achieve skill. It is possible that instruments may yet be devised which will help the glider pilot in taking advantage of air conditions of every kind. But even without instruments, it can be safely said that in spite of these difficulties, piloting the glider is within the reach of any young man, physically sound, with keen perceptive faculties and a good sense of balance.

Nor is building a glider such a terrifying matter. The materials required are not expensive. At a recent German meet at Wasserkuppe, one machine built of inexpensive bits of metal and wood was transported 20 miles to the meet in a push cart, yet put up an excellent and consistent performance day after day. Small boards of well-seasoned wood, a few sheets of thin-gage mild steel, readily obtainable from any large hardware house, some few special wires and turnbuckles, readily obtainable from aircraft supply houses, a few yards of airplane cloth, or some thin veneer, are substantially all the materials needed. Nor is very elaborate shop equipment needed by the amateur. The glider can be built in one's backyard with a few simple tools. Any slightly difficult wood or metal work can be readily farmed out to some small local machine or wood shop.

It is in the planning or designing of a glider that an amateur constructor must exercise the greatest care, if he wishes to build an original craft. While amateurs may ultimately develop useful and novel forms, mere "freak" machines are doomed to be a disappointment. The best gliders are those which utilize in the best possible fashion certain very simple laws of aerodynamics. "Bats" and "flying fish" and other monstrosities never succeeded in making but the shortest glides and show little or no stability.

Certain basic requirements must be fulfilled. These include light construction, so that a light loading in proportion to the wing area may be secured; a high aerodynamic efficiency; stability in flight; ample control under all conditions; and ample strength, combined with as light construction as is consonant with strength.

Light loading in proportion to the wing area is important because this means ease in get-away, and slow and easy landing. For high aerodynamic efficiency, a clean, graceful appearance is necessary because this means a small gliding angle, less loss of altitude when there is no favorable current, and maximum gain of altitude when there is a favorable current. Stability and correct balance in the glider are as important as in the powered airplane, and are achieved by much the same methods. A study of the disposition of the center of gravity relative to the wings and the setting of the tail relative to the wings are well worth while. Ample control surface areas are essential because the glider is so susceptible to air gusts, and at the same time the effectiveness of the controls is less than in speedy, high-powered airplanes. In considering strength, it is true that a glider never has to meet the violent loads which may come on the powered airplane, but it is much lighter so that adequate strength is almost as hard to secure as in the airplane proper. Finally, there must be an appropriate launching mechanism, a form of rubber catapult, or if hauling by a rope is used the rope must be automatically released when the machine leaves the ground.



Typical low-power airplane in flight. This is the R III sport monoplane developed in Germany

Typical glider flown in one of the French gliding meets. Note the trim and substantial construction

An American Cycleplane Attempt

Aerodynamic features embodied in the cycleplane that will have a material bearing on the future construction of smaller aircraft are said to have been proved with the first successful flight of an American-made machine.

The "Scientific Curiosity," so termed by its inventor, W. F. Gerhardt, a McCook Field employe and former officer of the Air Service, is propelled by a set of pedals similar to those used on a bicycle. By a chain arrangement, when pedalled, the propeller revolves, and in moving forward the cycleplane is lifted from the ground.

A cycleplane of much more stable construction and capable of lengthy flights in the air is promised by the inventor as the outgrowth of successful experiments with the original model.

Seven wings give the cycleplane its lift; it has no ailerons; its upward flight is governed by the elevator in much the same manner as the usual airplane. According to the inventor, the measured power required for flight is less than that which can be developed with the propeller operated with the foot pedals.

Aviation progress of late has been exceptionally rapid and quite spectacular, so much so that it has found considerable space in the daily press and in daily conversation. The thrilling flights of Lieut. Russell Maughan, the inauguration of coast-to-coast aerial mail, the completion and trial flights of the giant helium-filled, American-built dirigible "Z-R1," the smashing of records for speed, endurance and altitude—these are but a few of the numerous steps forward, which will be dealt with in a comprehensive manner in an early issue.

A Delicate Balance

DR. PAUL R. HEYL, of the Bureau of Standards, has constructed a balance so delicate that it will weigh three pounds with an error of not more than one part in a billion. The method involves the weighing of large crystals in varying positions.

The balance is of the general type of chemical balance used for weighing relatively large quantities, but fitted with every latest appliance to avoid error. No human hand comes anywhere near the balance when it is in use. The crystal to be weighed is first placed in the required position in a sort of frame connected with a series of rods proceeding from the balance case and extending through a brick wall about six feet away. It is then weighed to what would be called extreme accuracy by the experimenter standing in the balance room and putting in the heavier weights by hand.

The whole balance is then encased in movable walls of cork composition about two inches thick, leaving just room enough for the control rods and for the reflection of a beam of light on a mirror, the swings of which measure the final balancing. The experimenter then leaves the room which is closed tightly with a double door and left to come to a uniform temperature. This takes nearly an hour, after which the room does not vary one-tenth of a degree from one part to another. It is most important that the two arms of the balance shall not vary in temperature by more than one-thousandth of a degree, as this would introduce into the experiment an error of one part in several million, which would ruin its value. The weighing is then made by the operator sitting outside the brick wall and controlling the final delicate weights with the rods projecting through it.

Villa's Buried Treasure

AT first blush it would seem that we have no interest in Villa's bars of gold or bags of silver which he buried at night on his ranch, and indeed we have not; but some of our readers probably will have and we shall be asked to recommend the best divining rod and the shortest route to Mexico.

The story of buried money never palls and is never diminished in the telling. Indeed, legends of buried treasure are better than compound interest, for they are compounded every time they are told. From time to time expeditions are fitted out to visit the Cocos Islands or some other lair of pirate crews of the long ago. Robert Louis Stevenson knew this weakness of the human race who desire honestly to find a treasure-trove usually left by an essentially dishonest or criminal crew, and capitalized it in that rattling good story, "Treasure Island."

But all this is getting away from the divining rod. As far as all our investigations have gone, the searches by lay persons for hidden gold and silver with artificial devices have all been abortive, and we think that the Government is very much of the same opinion, for the pamphlet on divining rods, which is among their "best sellers," is eagerly sought for. We do not say that an expert geologist may not be *helped* by electrical devices. All those who have them are so very chary of ever letting one look even at the outside that our attitude is still that of a skeptic. So let Villa's buried treasure lie, for no foreigner would ever get out of the country alive with the pot of gold at the end of the rainbow, even if he found it. That fugitive from justice, Grover Cleveland Bergdoll, is believed to have buried a large sum in gold coin somewhere in Maryland. One would think that the divining rod adepts would hasten to its exact location and dig.

Saving a Cathedral by Compressed Air

Restoring Lincoln Cathedral by the Compressed Air Drill and Grouting

THIS is the story of the rescue from collapse of one of the greatest cathedrals of Great Britain, by means of the compressed-air drill and cement grout forced into its fissured walls under air pressure. Much as we may admire the architectural beauties and wonder at the size and majestic dignity of the medieval cathedrals, it has to be admitted that in many of them the work of these early masons was of very rough and inferior character. This is particularly true of the early Norman work of the twelfth and thirteenth centuries. The construction during the fourteenth, fifteenth and sixteenth centuries was generally of a better quality.

The trouble with the Norman work was that the massive piers, ten feet to twelve feet in diameter, and the walls from six to eight feet in thickness, consisted of an interior of rough rubble work set in mortar, with an outer casing of dressed stone with squared and fairly well-fitted joints. In the course of the centuries the mortar, which was often of an inferior quality, deteriorated and lost its binding and holding quality; and from the thirteenth century down to the present time much of the early work has given unending trouble. Naturally, the principal difficulty has been experienced with the towers, and particularly those at the crossing of the nave and transept. Here the super-incumbent tower load, of from 3000 to 5000 tons weight, proved too much for the four piers upon which it rested, with the result that in many of the cathedrals, both in England and France, the piers have crushed or buckled, and the whole tower has come crashing down upon the church below. This happened at Winchester, Chichester, and to the first central tower at Lincoln, not to mention several others which suffered the same fate.

Several insecure towers have been saved from collapse, during the reconstruction work of the last one hundred years, only by emergency repairs in which the tower above was held up by a perfect forest of massive timber shoring, while liquid cement grout was poured into the interior rubble work to bind the mass once more, as far as possible, into a solid and unyielding support.

The present article deals with the northwest tower of Lincoln Cathedral which, in our illustration, is the one to the right showing above the main roof. The lower part of the two western towers, to about the level of the ridge of the roof, is of Norman construction; as will be evident from a study of the round arched windows and the plain square buttressing at the corners. The upper part of the towers was added in the later reconstruction and enlargement of the cathedral. This Norman work is characterized by the rudeness of construction referred to above. The present dangerous condition of the northwest tower, as shown in our photographs, is due partly to the nature of the construction, and also to the fact that the cathedral was badly wrecked by a violent earthquake, which took place in the year 1185, and necessitated the rebuilding of the Norman Cathedral.

Westerly towers of Lincoln Cathedral. The right-hand tower, it will be seen, leans to the right

The cracks which were opened by the earthquake in the northwest tower, in spite of the continual repair work done at various times during the past seven centuries, have steadily widened, and the tower has settled in a northerly direction until the deviation is visible to the eye, as will be noticed from our photograph showing the westerly towers. The condition of the towers, and indeed of many other parts of the cathedral, was so serious that a vigorous campaign to secure the $250,000 needed to save the cathedral was started a few years ago, and the present work of thoroughgoing repair was undertaken in 1922.

The walls of the tower are enormously massive, reaching in one place a thickness of twenty feet; nevertheless, in one wall the cracks have opened to the extent of twelve inches. It would be impossible to pull the wall back into its original position, and what is now being attempted, and very successfully accomplished, is to fill up the cracks with grout and thus hold the structure from any further distortion or settlement. This has been rendered possible by the use of a very efficient American tool, the compressed-air drill. With this most useful tool holes are drilled many feet into the heart of the wall, and liquid grout is forced into the mass of masonry, where it follows along every crevice to the utmost extent of the fracture, filling all the voids and binding the rubble work into one solid and immovable mass. As compared with the old method of drilling by hand, the use of compressed-air drills and of pneumatic pressure for forcing the grout has cut down the cost of these repairs enormously. Indeed, it may be said without exaggeration that the compressed-air drill has saved this magnificent cathedral, which has been visited by thousands of Americans, from destruction. A considerable part of the funds for the work has been contributed in America; and the Dean and Chapter have decided to make the repairs to the large central tower at the crossing, which is not visible in our photograph, entirely with such funds as are subscribed in the United States, and to constitute this work a memorial to American cooperation. Of the total sum of $50,000 required for this tower about one-half has been subscribed.

A Photographic Museum

IN Prague there is a wonderful museum devoted to buttons and other fastenings for clothing. It was founded by a button manufacturer who thought that, as his fortune had been derived from these humble objects, it would be a graceful thing to found and endow a special museum of this nature. The other day we were reading a letter in a daily paper which gave an excellent idea for a museum, and we think it is worth while to pass it on to our readers. The letter suggested that Mr. George Eastman found a museum of photography. The idea is fundamentally sound, as it would be most appropriate for one who has done so much for photography to go a step further and collect all the historical memorials while they can be collected. Of course, Mr. Eastman's profits are legitimate and are his own, but he has shown such great generosity in founding cultural schools of music and the silent drama, that it would not be impertinent, we think, to suggest to him that he is the logical person to start such an institution, the museum to pair with his great laboratory where so much work in pure science is carried on. Of course we have a few exhibits in the National Museum of Washington and in the Science Museum in London, which are useful as far as they go; but what is needed is a real museum containing all possible exhibits which will elucidate this beautiful art.

Tests of New Design of Large Hawsers

TENSILE tests have recently been made at the Bureau of Standards on 21 samples of very large hawsers. The purpose of these tests was to determine the comparative strength of a new type of construction for manila rope as compared with the standard method of construction. In the new type the inner yarns of the strands are untwisted. The strands are made up of several outer layers of twisted yarns binding this inner compact mass of fibers; these strands being twisted in the usual manner to form the rope. The tests showed that in all cases the new type of construction increases the strength of the rope.

This wide crack is typical of the disruption that was taking place in the old Norman Tower

Even this tower window, 180 feet above ground, was falling apart. Note the temporary props

Cement grout forced at high pressure into holes drilled in the masonry solidifies the whole mass

Automobiles and Near-Automobiles

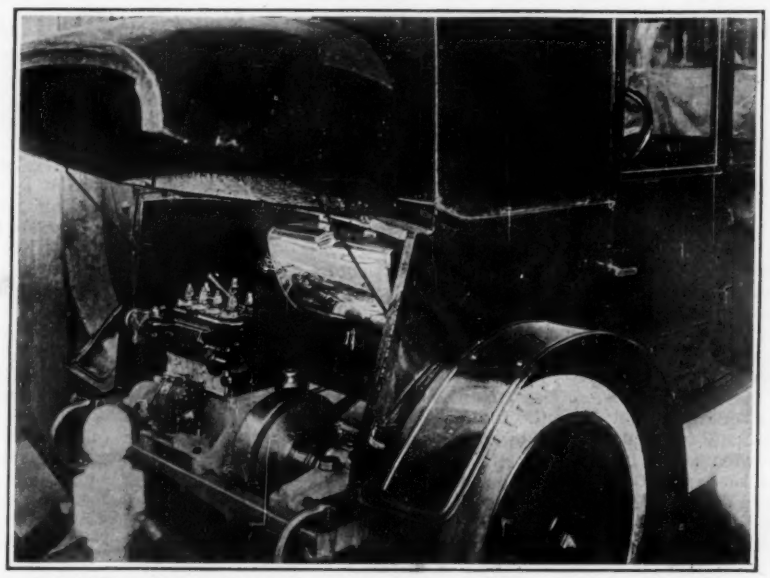
ONE of the subjects that is perennially green is that of the small automotive vehicle which may be classified as an actual car or as a motorcycle, according to the individual predilection of the classifier or the state of his digestion. There seems to be no end to the number of ways in which the automobile and the power bike may thus be hybridized. One of the latest and we think one of the neatest specimens is illustrated at the upper right corner of the page. Our correspondent caught it on the fly in London's shopping center, where it was the cynosure of all eyes. It is more cycle than car, its major claim to the latter classification consisting in the presence of a seat rather than a saddle. A seat for the driver, that is to say, the passenger, if one is carried, apparently must trust to the fortunes of war. One might ride for a long distance on that smooth platform behind the driver, but if the plaints about the condition of the London streets are based upon facts, one would not probably stick for very long.

The springing of this vehicle is rather more in the direction of the car than in that of the cycle, too. There is a long, semi or quarter-elliptic affair of four leaves running forward from a point on the frame beside the rear wheel, to an anchorage beneath the driver. Starting is in traditional motor-bike style, the kick-pedal being plainly visible in our view; and steering follows the vogue of the handle-bar rather than that of the wheel. The attainable speed is given as 40 miles per hour, and the gasoline consumption is highly favorable. In this country, in fact, this feature alone would stamp the machine as a cycle rather than a car, but the Briton is quite accustomed to his light car that does anywhere up to 50 miles per gallon, and that is beyond question an automobile. Indeed, so largely has he developed this sort of conveyance that the good old Tin Lizzie no longer qualifies for sporting events that are closed to "light cars." Both in weight and in piston displacement, the flivver escapes this category in the England of today, so that the Briton is far less loath than us to recognize as an automobile a hybrid of the sort illustrated on this page.

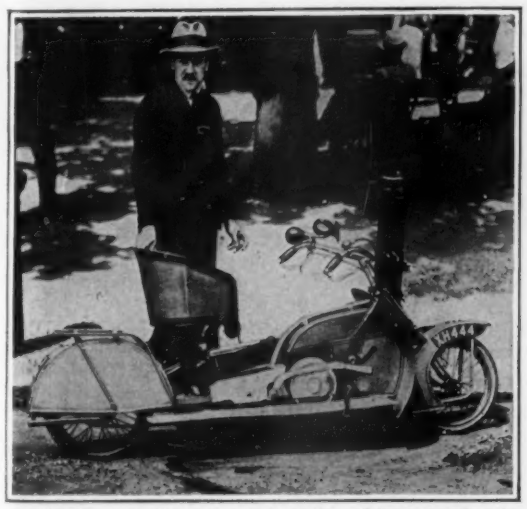
The one at the lower left is another London type. This vehicle makes the definite claim to classification as a car, the owner and designer referring to it as a runabout. It carries a 2½-horsepower engine, and its constructor proudly asserts that it is faster than any motorcycle of similar power. It will be noted that he has bolstered his claim to the proprietorship of a real car by installing running boards and a hand brake; and that again the driver rides in the comparative luxury of a regular seat. Indeed, he has less the effect of riding astride than his compatriot diagonally opposite him on the page, and is sufficiently near the road to get all the thrills of racing out of a very moderate speed.

The photograph in the center of the page is of French origin, and shows a vehicle which is plainly enough a regular automobile. It represents an effort to shorten the wheel-base for tight driving in the congested city. The tiny four-cylinder motor is installed at the rear of the car instead of the front. An effort is made to balance weight by placing the engine proper at one side and the flywheel at the other; and the position of the latter indicates that full advantage has been taken of the motor's unique location to avoid the necessity of transmitting the power around a corner to the rear axle. The horsepower is given as eight. The car was exhibited at the recent French automobile show, where it elicited much favorable comment.

One of Britain's latest efforts to combine in a single design the advantages of car and cycle



A light French car with engine at the rear, and shafts parallel to the axles



Built close to the ground describes this example of the London cycle-car

Forests and Fertility

IT is one of the unfortunate results of civilization that while it enables men to live in much larger numbers on the ground, they can only do so by annihilating other forms of life. In this way, man has ruthlessly destroyed trees to make his house and to make way for his flocks, without considering what effect their destruction may have on the climate and resources of the region he lives in. This point never was considered until the increasing ill effects forced themselves on man's notice, by curtailing his means of livelihood. It cannot be altogether accidental that where mountains and uplands have been denuded of the forests which naturally clothed them, the results have always been destructive floods in the rainy season and shrivelled-up rivers in the dry.

Most people have noticed that on the hottest day a growing leaf is always cold, the reason being that the plant has discovered exactly what amount of moisture it is necessary to evaporate from its pores to keep its temperature down. Humanity does exactly the same thing when it is properly acclimatized. In the hottest climates, the natives' skins are normally as cold as a snake's whilst the visitor is streaming with useless perspiration, too profuse to evaporate. The plant has to absorb water through its roots from the ground, so that if it cannot penetrate deep enough to get sufficient moisture, it dies. The leaves of a tree are always cool and evaporating moisture, and it follows that every breeze that blows over them is cooled and moistened, which means that the dew-point has been lowered. If the wind now encounters a hill-slope, on blowing up it, the dew-point, is still further lowered by the chill caused, and rain is all the more likely to result. The ground also under the tree is shaded from the sun, and is therefore cooler and more moist than if it were exposed. In addition, when rain falls, it is easily conducted down the holes made by the roots into the soil, and there is not so much left on the surface to run off or be lost in evaporation.

In the other case, when there are no trees, the soil gets very hot and dry, and the herbage, having roots that do not penetrate so deeply, gets parched. Since the ground surface is caked, any rain runs off freely, and as the earth has been baked hot by the sun, there is much loss in evaporation. More than this, since the quantity of water running off is so much larger, its scoring and carrying powers are much greater. The result is that a great quantity of stones, earth, humus and detritus is always swept off slopes that have been deforested, filling up and choking the river-beds, wherever the slopes are too flat to enable the current to carry it farther. A good example of this is the port of Pisa.

In the fourteenth and fifteenth centuries the Apennines became deforested, some say because it was believed that the devastating plagues of the Middle Ages were caused by trees, or it may have been to get more pasture for the growth of the wool which made Florence so rich and famous. At any rate the result was disastrous. The Apennine pastures dried up, the rivers rapidly rose in flood and carried more and more gravel down to the sea. The harbor of Pisa became choked and obliterated, the Pisans ignorantly blaming the Genoese for having done it in one of their raids. Now there are miles of unhealthy marshes between Pisa and the sea, and there is no harbor for even a row-boat to shelter in, and this is all traceable to the ground getting hard and caked in the absence of trees.—*Abstract from articles by Col. H. de H. in "Discovery" (British) for May, 1923.*

A New Anesthetic from Sleeping Flowers

AS far back as 1908 florists complained that carnations when placed in greenhouses would go to sleep and those which had not opened would fail to do so, causing great loss in their business. Investigation proved leaky gas fixtures to be the cause. Gas contains four per cent of ethylene, and it was shown that one part of this gas in 2,000,000 parts of air caused already open flowers to close. Other investigations showed a similar effect of the gas on other plants. This led Dr. Luckhardt and Mr. Carter of the University of Chicago, recently to test the gas as an anesthetic. The gas was tried first on numerous animals, such as frogs, mice, guinea-pigs, rabbits and kittens, that were all found to be put to sleep by it without any apparent after-effects of a disagreeable sort. The anesthetic was finally tried on a dog who went out completely in less than five minutes on a mixture of 90 per cent ethylene and 10 per cent oxygen. The experimenters then tried it on themselves. They describe the effect of the gas mixed with oxygen as exhilarating and giving a sense of well-being. They became unconscious and then subsequently recovered without realization that they had been unconscious. Several students then volunteered. Complete surgical anesthesia with muscular relaxation was produced in a few minutes. Subjects had pins thrust through their arms, were pinched severely enough to leave black and blue areas, and one was beaten on the soles of his feet with a Stillson wrench without any sensation whatever or memory of discomfort. Recovery was complete in a few minutes. The only after-effect was slight weakness and slight nausea. In every case the subject ate a full meal within a few hours after recovery. It is claimed that the new anesthetic gives loss of sensation long before complete surgical anesthesia is established, that it may be maintained with complete muscular relaxation, yet without any sign of asphyxia, shortness of breath or effect upon the blood pressure; and that there is rapid recovery even after long administration without evidence of after-effects.

Important as this discovery is to all of us, there is nothing definite as yet to indicate its importance to the medical world. However, one thing is obvious, and that is the relatively insignificant cost of this new anesthetic. Furthermore, it is almost universally available, although its use must be kept in competent hands to avoid any possible danger from over-dosage.

Left: Dropped through a glass tube upon a hardened steel plate, the ball's rebound is a measure of its hardness and resiliency. *Center:* Taper-gaging the steel sphere to determine its exact diameter. *Right:* Examining the balls with a 20-power microscope, in the search for surface imperfections

Tests and checks to which high-grade ball bearings are subjected before they leave the factory

Ball Bearings and How They Are Made

The Tiny but Perfect Spheres that Keep Down the Friction Toll in Modern Machinery

By Robert G. Skerrett

THERE was a time, and that not long ago, when a lubricating film of some sort was the only means of offsetting the clinging or hampering contact between contiguous sliding or revolving surfaces, and, even so, there still remained the demand for more or less unproductive power to overcome the inertia of the "dead load" and to keep the mass in motion. Thanks to the development of ball and of roller bearings the effect of these physical conditions has been very greatly altered for the better; a lesser effort can achieve more than was feasible before the adoption of these beautifully and accurately fashioned bodies of steel.

There are no statistics available to tell the whole story of America's annual production and use of these anti-frictional parts, but the output is numerically immense, and the fields of application both wide and manifold. They have a place in the get-up of every automobile, motor truck and tractor; they are employed by the million in electric motors, sewing machines, talking machines, typewriters, gyroscopic compasses, and an endless variety of other mechanisms; and thousands of machine tools perform their work at a lower cost by reason of their ball or roller bearings. Indeed, the list would be well-nigh endless if every service of these helpful mediums were recited; and the engineer is striving continually to find other ways to utilize them. Passing over the roller bearing for the time, we shall tell here the story of the manufacture of its older brother, the ball bearing.

The use of these bearings has become so general and they can be purchased so readily that the average person looks upon them as a comparative commonplace and gives little thought to how they are made. To him a sixteenth of an inch is a relatively diminutive measurement, and yet the steel balls for bearings are fashioned to a dimensional precision of a ten-thousandth of an inch. This is essential, for if the assembled spheres in any bearing were not of well-nigh perfect uniformity in size the load upon them would not be evenly distributed, and the bigger member of the group would have laid upon it the whole burden and would probably be shattered in consequence. And the same technical cunning and adherence to precision are essential in turning out upon a commercial scale the rings or races which hold the balls.

Now let us follow through the various stages of the making of ball bearings—starting with the primary raw material. Chrome steel is required for these parts; and while its composition may vary to a degree, it contains generally 1.28 degrees chromium, 1.06 carbon and 0.5 manganese. The metal, when oil-hardened and tempered, has a fine silky grain. None of this steel is issued for working up until it has been subjected to both chemical and physical tests in the plant laboratory; and it is customary to cut from a sample bar a piece one and a half diameters long, and crush it cold to two-thirds of its original length. The metal is not acceptable if it shows any sign of flaw or splitting after this trial.

High-grade balls up to three-eighths inch in diameter are frequently machined directly from rod steel, and for this purpose a form cutter is employed which turns out balls slightly over size. Another method is to machine the "wire" into slugs or blanks which then pass on to dies which forge them cold into balls having a fine fin around their centers. These balls are next annealed and then run through knurling machines, each equipped with a pair of case-hardened steel plates, between which the fins are ground away and the little spheres are made ready for rough grinding which transforms them into perfect spheres, slightly over size. The third stage is the heat treatment, and this is alike both for the balls produced by the form cutter and those which are manufactured by the dual process of machining and cold forging.

Balls of three-eighths inch and over are usually forged hot by presses equipped with suitable dies, and a sufficient length of rod or wire is used in each case to make a string of from eight to ten spheres at a time. The balls so modeled are approximately spherical and are bound to one another by a thin strip of metal called a "flash." This is afterward sheared and the separated balls are given a rough grinding to remove the flash and to shape them into roundness. In some establishments the practice is to anneal the forged balls in gas-fired furnaces before rough grinding.

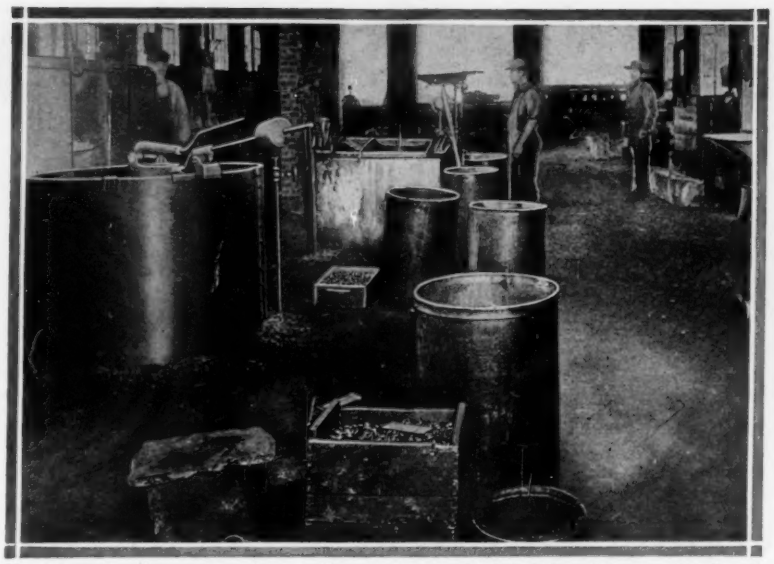
The grinding machines, which vary somewhat according to the pattern used, consist in the main of two oppositely rotating horizontal wheels, one which does the grinding. The balls are held in an annular V-shaped groove cut in the nether wheel or by a similar runway formed by two guide rings, interposed between the upper and the lower wheels. These wheels are mounted slightly off center to one another, and the result, in combination with the action of the V-shaped groove, is to cause the balls to revolve continuously in changing directions so that every part of their surfaces is exposed to the abrasive action of the carborundum wheel. The grinding operation is done dry—the dust being carried off by a suction attachment; and the average machine will treat about a hundred one-half inch balls, for instance, every twenty minutes.

No small part of the acceptability of the ultimately finished ball depends upon the manner in which it is first hardened and then annealed to relieve it of internal stresses. For this purpose the balls are fed into gas-fired furnaces—often designed to rotate; and at uniform intervals groups of the balls flow in for treatment through pipes which shield them the while from the oxidizing action of the atmosphere. After being subjected for a suitable period to a temperature of approximately 1470 degrees Fahrenheit, the balls are automatically discharged

Assembly and inspection department of a well equipped ball-bearing factory

from the furnaces and dropped into a bath of oil or water—the choice of fluid depending upon the size of the balls. The depth of the tank is regulated so that the balls will be cold by the time they reach the bottom, whence they are moved by a mechanical conveyor. The furnaces are controlled by electric pyrometers, which make it possible to hold the temperatures at points which experience has proved best suited to each size of ball and to the particular class of steel used for them.

After hardening, the balls are tempered by being boiled, according to their size, in oil or water for several hours. While this temperature is relatively low it induces physical changes in the steel, "seasons" it, and, without affecting the surface hardness, brings about internal readjustments of the metal and puts it in a state to withstand a considerably greater crushing stress. When the balls have been annealed, they are then freed of any attached scale in tumbling barrels within which they are agitated in the presence of a mixture of potash and grit; and this is succeeded by a second barreling operation which, by recourse to potash and a fine abrasive, finishes the surfaces of the balls to a point where they are ready to undergo the hardness test. The manner of making this varies. At some factories ten balls from every batch are crushed successively to destruction in a hydraulic press; and the pressure required to do this in each case is indicated by a gage. Having passed this test, the balls are now given their final finish and polish.



Heat-treating furnaces and quenching tanks in which ball bearings are hardened

The finish grinding may be done either by machines substantially like the rough grinding machines, save that finer grinding wheels are used and the work is done in oil, or apparatus may be employed of the knurling type, already referred to. The grinding wheel is forced against the balls at a pressure of from 400 to 600 pounds. The final polish is imparted by two or three "lapping" operations. For this purpose "stones" of fine grade are substituted for the harder cutting wheels and then a leather wheel, with a mixture of crocus and oil, completes this phase of the process. At some plants the balls leave the first lapping machine from three to ten thousandths of an inch over size. From the second machine they issue one ten-thousandth of an inch over size; and from the last machine they come substantially exact as to size and of a high finish. Glittering as they are, however, there is yet more to be done to them before they acquire the perfect polish demanded in the commercial article.

Following the lapping, the balls are tumbled in a barrel containing rouge and a quantity of bits of leather; and when this has continued for many hours the balls are given their final shine in another tumbling barrel, charged with a solution of potash, in which they remain for a period of from eight to sixteen hours. Care has to be taken that this treatment does not go on long enough to spoil the color of the balls by imparting to them a brownish tinge. The last step involves rolling the balls about in a third barrel carrying a mixture of leather and sawdust, and this dries and leaves them silvery spheres of wonderful smoothness.

While the lapping and tumbling operations are in progress, the balls are from time to time very carefully gaged. The concluding gaging, however, does not take place until about 12 hours after the balls are removed from the drying barrel. This allows ample time for them to cool down. In the meantime they are visually inspected for cracks, flaws, or soft spots. Girls are employed for this work, and they show remarkable skill in detecting quickly defects which would scarcely be caught by the untrained eye even when pointed out.

The inspection is done in a well-lighted department, and each girl, seated at a table, has a shallow tray in which is laid a bottom of glass or a sheet of white paper, the reflected light in either case serving to illumine the underside of the ball so that no imperfection can hide in the shadows. Ten or a dozen balls are thus examined simultaneously. By tipping the tray slightly the balls are induced to roll away from the keen-eyed operative, and the least lack of sphericity in a ball will cause it to deviate laterally from the straight path. Defective balls are picked up by magnets or pincers and cast aside, while the remaining ones are dropped into a box for gaging. In some plants the inspectors wear soft chamois gloves, for the least touch of the bare fingers may produce a rust spot. In the course of an eight-hour day, a girl expert can examine quite 5,000 half-inch balls, for example.

From the inspection department the balls are sent to a gaging room, where the atmosphere is maintained uniformly at a prescribed temperature; and there the balls are run through machines which automatically classify them into sizes varying by steps of five ten-thousandths of an inch. The process consists fundamentally in letting the balls roll down between a pair of slightly spreading metal guides; and as they travel along the tapering slot so formed the balls drop successively through openings, corresponding to their diameters, into bins or boxes beneath. Over-sized balls are deposited in the lowest and last receptacle. The final dimensional test is made by girls who do the gaging by pushing the balls through rings or perforated plates, which are accurate within the limits of possible measurement. The operatives judge by the sense of touch, *i. e.*, the ease or reluctance with which the balls can be put through the prescribed ring or plate, whether the spheres are acceptable or not.

While the guaranteed accuracy of the balls is within the margin just cited, there are factories which produce these steel spheres considerably closer to the stipulated diametric dimension. For instance, the balls are graded into eight sizes intermediate between the limiting sizes, and the difference, therefore, between two such successive groups is only one fifty-thousandth of an inch. All the balls for any one bearing are taken from but one of these groups, and in this way the spheres in a given bearing are as nearly identical as it is humanly and mechanically feasible to make them.

No less care is exercised in the manufacture of the races and cages which hold the steel balls of a ball bearing. The inner and outer rings for the larger bearings are machined directly from oil-hardened, drawn-steel tubing, while the rings for the smaller sizes are cut from solid bars of case-hardened steel—the inner ring being made from the core removed in machining the outer ring. Whether tubing or bars be employed, the material is chrome steel.

When the rings have been cut and machined to within eight or twelve thousandths of an inch of their ultimate diameters, the bore is beveled at each end, and a groove is turned in the ring for the ball-track. With this work done, notches are cut between a side and the ball-race so that the balls can later on be inserted. Practice in this respect varies in different plants. The rings are now ready to be heated in gas-fired furnaces and then hardened by dropping them into an oil bath. They are next tempered by boiling for a considerable while in water. The tempered rings are tested for hardness and physical integrity by being dropped edgewise on to a steel anvil. This is called the bounce test, the height of drop aud the corresponding height of rebound being different for each size of ring. The examiner determines by the bell-like sound of the dropping ring whether it is perfect or faulty both structually and as regards hardness.

Having passed this test, the rings are ready to be ground to their final sizes; and this is done with remarkable accuracy. Now comes the still more important step of grinding the ball-track or race, the path of which is of a radius only about 3 per cent greater than that of the balls which run in it. In order that the artisan can do his part to a nicety, his grinding machine is frequently equipped with a gage which visibly indicates just how the process is progressing. When a ring is thus finished, it is subjected to a final inspection which is quite thorough. Here, again, expert training plays its part, and the qualified inspector, merely by employing a scraper, fashioned out of a

(*Continued on page 375*)

Left: Apparatus for testing the ball race of the outer ring. *Center:* Loading a ball bearing by filling the cage and assembling the inner and outer rings. *Right:* Gage for checking the diameters of the balls

Putting the balls and the races together into the finished bearing

1. Uroglena, magnified 150 diameters; this organism causes cod-liver-oil flavor. 2. Asterionella (150 diameters); note regularly spaced coloring matter in the arms. This causes geranium and fishy odors. 3. Appearance of asterionella after copper sulfate treatment; note destruction of coloring matter, and faint, shell-like appearance. 4. Synura (150 diameters); note faint outlines of cells outside the (yellow) coloring matter. This organism is responsible for the familiar cucumber flavor in water.

Three types of micro-organisms whose presence in water gives rise to bad odor and flavor

Keeping Our Water Fit to Drink

Microscopic Denizens of Our Reservoirs, and the Means Used to Keep Them Under Control

By Dr. Frank E. Hale

Chief Chemist, Bureau of Water Supply, New York City

THE water supply of New York City is impounded in approximately fifty reservoirs. Many of these are of extremely large capacity. Ashokan reservoir alone contains 130 billion gallons; Kensico, 30 billion gallons; Croton Lake 34 billion gallons and nine other reservoirs on the Croton watershed range from 3 to 16 billion gallons each. The entire Croton watershed with its twelve reservoirs and six lakes has a combined storage of 105 billion gallons. Only one large reservoir, Hempstead Storage, exists upon the Long Island watershed. Several distribution reservoirs within the city limits are of nearly a billion gallons capacity. The mere handling of such immense quantities of water presents a serious problem.

The Department of Water Supply has three laboratories and microscopic examinations are made at all three. Every one of the above reservoirs requires examination on a regular schedule not only at one point, but usually at several. Reservoirs with top and bottom draft are sampled at top and bottom and the largest and the most important are sampled at several points. Last year 4,177 microscopic examinations were made.

From the standpoint of palatability and of the esthetic character of water supply there is no more important examination than the microscopical analysis. This examination discloses and measures the minute animal and plant life that is present in all surface waters and in some well waters. Large amounts cause an unsightly turbidity and even relatively small quantities frequently cause complaint because of a scum produced when bath tubs are filled with hot water or of a stain left upon the sides of the white porcelain. The water of swimming pools, if unfiltered, may be unsightly. Industrial enterprises may be affected; for example, the staining of clothes in laundries and interference with the manufacture of correct colors by dye manufacturers and with the dyeing of goods by the dyers. Photography may also be influenced. The presence of certain types of microscopic organisms frequently serves to identify the source of a water. The contamination of a well supply by surface water may be indicated by the presence of microscopic organisms.

By far the most important reason for determining microscopic organisms is their connection with disagreeable tastes and odors in water supply. Those so-called littoral growths, which are attached to the banks or bottoms of reservoirs, and which attract the quickest attention, are not concerned as a rule. The trouble is caused by minute floating forms, which manufacture essential oils or perfumes like those of flowers. Exceedingly minute amounts produce pleasant aromatic geranium or grassy odors which become fishy, oily, pungent or vile in larger amounts or upon decay of the plant growths. Particular species may frequently be identified by the odor by those who are trained in this work.

Three groups of odors are distinguished: aromatic (geranium), caused by diatomaceae; grassy, caused by cyanophyceae, and fishy, caused by chlorophyceae, diatomaceae and protozoa. There are in all 22 species which have been known to cause trouble.

In New York City's supply, despite the diversity of its sources, the only species which have given offense from odors or taste have been Asterionella, Tabellaria, Anabaena, Aphanizomenon (with admixtures of Clathrocystis, Microcystis and Coelosphaerium), Uroglena, Synura, Dinobryon and Peridinium.

Asterionella, when present in 500 to 1,000 standard units per cubic centimeter, produces a slightly aromatic odor. At 1,000 units, rarely less, the odor is distinctly similar to that of the geranium. The odor increases in intensity with increasing numbers until several thousand produce a fishy odor. The fishy odor is also produced when smaller quantities die.

Tabellaria, and similarly Asterionella, in very small amounts produces an earthy odor (also produced by large amounts of Synedra), passing through the aromatic, geranium and fishy stages with about the same relative quantities of organisms as Asterionella. At times the odor of Tabellaria has suggested illuminating gas, no other organisms being present.

Anabaena and Aphanizomenon, when present in 500 to 1,000 units, produce a faintly grassy odor like freshly-cut grass. With larger numbers the odor becomes pungent like nasturtium. In large numbers, or when decaying, the odor is of vile, pigpen character.

Uroglena produces an oily, fishy taste and odor, first noticeable in probably 500 to 1,000 units. In larger quantities it is very disagreeable, the flavor being that of cod liver oil.

Chlorination plant at the Kensico reservoir of the New York water-supply system

Synura may cause trouble apparently in any amount, judging from the recent experience, at least as little as 50 units. The taste is variously described as cucumber, muskmelon, fishy, etc. It leaves a bitter after-taste. The after-taste is noted when the undestroyed organisms are in the drinking supply and in such case there is but very slight first-taste. Water containing the dead organisms has an immediate first-taste and practically no after-taste.

Microscopic organisms apparently do not affect the health. Possibly the taste and odor at times produce nausea or distaste for food. It would take 12,000 units of Asterionella per cubic centimeter to add a milligram of solid matter to a glass of water, hence the practical impossibility of any chemical effect upon the body.

The first method of control is to shut off the troublesome reservoir and allow it to stand if possible. In three weeks to three months the trouble will usually disappear. This method cannot be employed with certain of the distribution reservoirs, as they are not equipped with a bypass. The second method is to shift draft from one portion of a reservoir to another if possible, as for instance, from the east basin to the west basin at Ashokan reservoir. The third method is to shift draft from one depth to another. Since 1912, draft at 75 feet depth at Croton Lake has reduced the organisms reaching the city by 75 per cent. Certain forms, particularly the Cyanophyceae, tend to float in the upper water. Probably due to temperature and light, the diatoms and protozoa may at times predominate in the upper water.

Both the Ashokan and the Kensico aerators have been employed to help remove the taste and odor-producing oils from microscopic organisms. The odor to leeward of the spray is obvious when growths are prevalent. Certain delicate organisms are partially disintegrated, Uroglena, Synura, Dinobryon, Anabaena and Asterionella. It is not the air but the splashing and jolting that produces the effect.

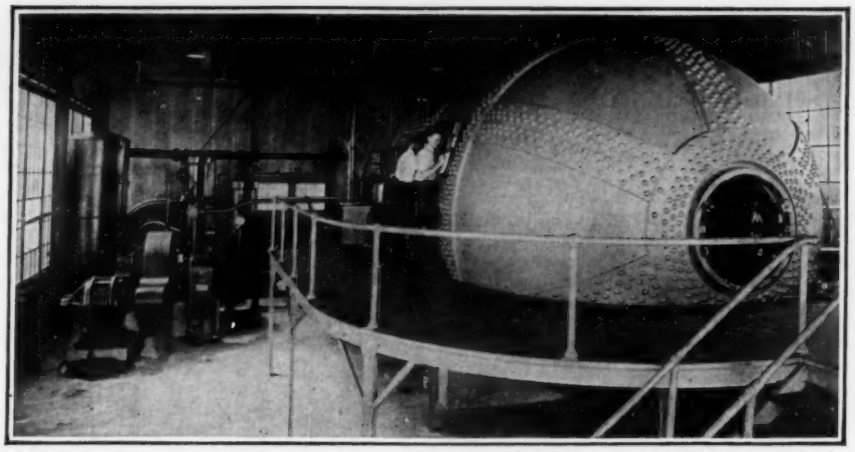
In the recent trouble with Synura in New York City's supply and previous experience with Tabellaria, it has been learned that chlorine partially kills certain microscopic organisms and sets free the tasteful oils; also, by large scale tests on the watershed, that increased dosage with chlorine will destroy the taste and odor in amounts of chlorine not too high for the excess to disappear within a reasonable time, thus not producing taste of chlorine in the water of the service taps.

The method of widest application in the destruction of microscopic organisms is that of Moore and Kellerman, the application of copper sulfate in dosage ranging from 0.05 to 1.00 parts per million by weight according to the particular species. The effect of treatment of microscopic organisms by copper sulfate is shown by an immediate intensification of distinctive odors, by reduction of the num-

(*Continued on page 375*)

A Midget Wind Tunnel That Works Like a Giant

BY the utilization and adaptation of compressed air for the testing of airplane models in a special wind tunnel erected expressly for that purpose, the National Advisory Committee for Aeronautics—one of the outstanding organizations of its character in existence—is performing some very remarkable work at its Langley Field, Virginia, laboratories where a midget experimental chamber of unusually small dimensions is now in active use.



Compressed-air wind-tunnel at Langley Field, showing observation platform and air compressor

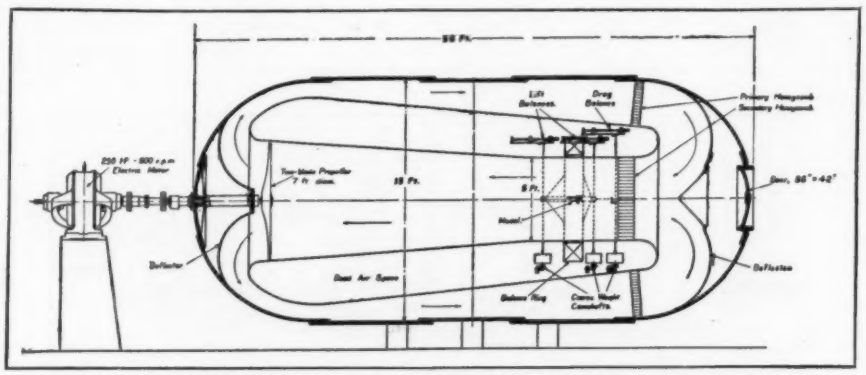
The theory of the usefulness of this particular type of tunnel, the first of its kind harnessed for research investigations in this country, is based upon the fact that at constant temperature, the density of the air increases in proportion to the absolute pressure. This simply means that a model of a wind tunnel one-twentieth full size where the pressure is maintained at 20 atmospheres provides conditions the same as those that occur where an airplane flies under natural conditions at the same speed as that used in the model tests. This system of testing eliminates all scale corrections and is productive of accurate results as reliable as though a full sized model were being used. The novel tunnel was originated and designed by Dr. Max M. Munk, while the mechanical equipments were designed by D. L. Bacon.

The tunnel proper is five feet in diameter at the experimental chamber and is enclosed in a cylindrical tank with hemispherical ends. The walls are hollow, providing an annular dead air space in which the balance mechanism is installed. The steel tank is strong enough to withstand an internal pressure of 20 atmospheres, while it is large enough to provide a return path for the air stream between the walls of the tunnel and the tank. A balance of novel construction is arranged for electrical control either by hand-operated switch or automatically from outside the tank. These manipulations of the switch attach or release heavy balancing weights by means of special cams or else they move lighter weights along the balance arms. The airplane model is attached to the balance by means of wires, there being three balance arms for measuring the lift, drag and pitching moments of the machine. Observations are taken through glass holes in the shell of the tank. The tank is inflated by two electrically-driven air compressors.

The steel tank mounted on a concrete foundation and partially surrounded by a working platform is 35 feet long, 15 feet in diameter and weighs 83 tons. An observer who is stationed on the platform makes settings and readings by looking into the tank through the small peep holes. The cast steel door that provides access to the curious tank chamber is at one end while the drive shaft for turning the propeller passes through the shell at the opposite end. The tunnel proper is made of wood, cylindrical at the experimental chamber with conical approach and exit sections supported within the tank by a structural steel frame. Trumpet shaped deflectors made of sheet metal are fitted into the tank at either end to assist in maintaining a smooth flow of air from the inner to the outer channel and vice versa.

Circulation of the air is effected by a two-blade propeller seven feet in diameter located in the outer end of the exit cone and driven at a speed of 900 revolutions a minute. A 250-horsepower motor mounted on a separate base at the end of the tank drives the propeller through a flexible coupling. This drive shaft is made tight against air leakage where it passes through the head of the tank by a loosely packed gland through which oil is circulated. This oil flows by gravity from a special oil reservoir maintained at tank pressure and is returned after use to the reservoir by a special motor-driven pump.

When operating at its greatest density, the new Langley Field air tunnel is equivalent in scale to a tunnel 100 feet in diameter running at 60 miles an hour. The tank can be inflated to 20 atmospheres in one and one-half hours by means of the two compressors. A primary compressor driven by a 260-horsepower motor is used to provide pressure conditions that range from one to eight atmospheres. If greater pressure is desired, a secondary or booster compressor is also yoked for service, it being driven by a 150-horsepower induction motor. The information obtained from the wind tunnel tests that are made at Langley Field can be directly applied by the designers at the drawing boards who are working on new types of airplane models.



Vertical longitudinal section of Langley Field's midget wind-tunnel

It is interesting to contrast this diminutive air tunnel with the huge French wind tunnel described in our August, 1923, issue. The French air tunnel has a wind tunnel 10 feet in diameter, and a fan which gives a maximum air current of 240 feet per second. The electrically-driven air fan alone is about 20 feet in diameter.

Line Radio Communication

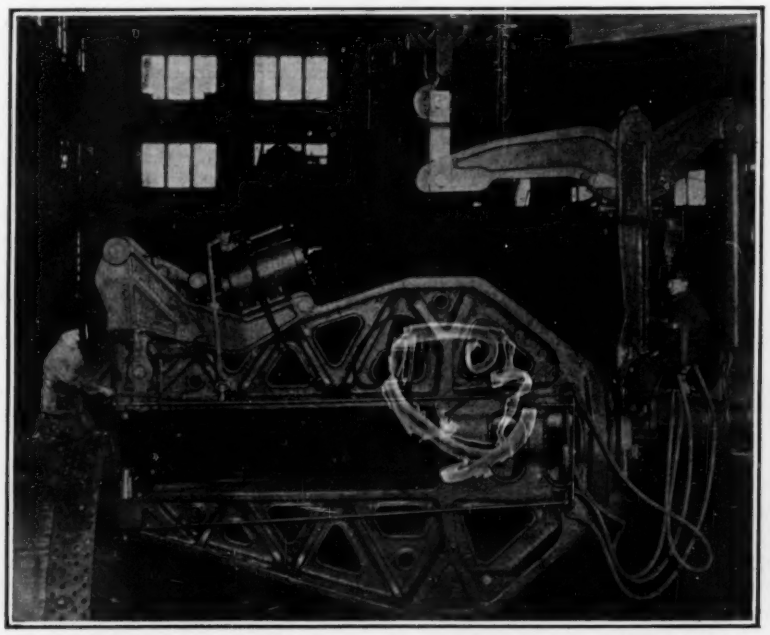
A PUBLICATION giving an introduction to the subject of line radio communication has recently been prepared under the direction of the Chief Signal Officer of the Army with the cooperation of the Bureau of Standards This pamphlet gives an explanation of how messages are carried to distant points by radio frequency currents directed over ordinary telephone lines or power wires. The fundamental principles of radio and its relation to line radio telegraphy and telephony are discussed. This pamphlet, Signal Corps Radio Communication Pamphlet No. 41, entitled "Introduction in Line Radio Communication," can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents per copy.

A 29-Ton Portable Riveter

IN connection with the Niagara Falls power development, the problem arose of constructing the spiral shell for the 70,000-horsepower turbine, together with the penstock. The size of this assembly is extraordinary; and since it must hold water without leakage under a pulsating pressure of about 110 pounds per square inch, the riveting of the plates must be of boiler quality. Owing to the size and weight of the volute and penstock, a portable riveter is required; while the large rivets and plates call for one of high tonnage and long reach.

These demands have been met by the design and construction of the huge machine illustrated on our cover this month. The total portable weight of this riveter is 57,750 pounds, as against 25,000 pounds for its largest portable predecessor. The frame is a single steel casting weighing 33,000 pounds; the additional weight resides in the spindle and the riveting mechanism.

The supporting mechanism is so designed that, when revolving the frame on the spindle or tilting it upward or downward from the horizontal, the center of gravity of the entire assembly hanging upon the crane hook is neither raised nor lowered. The suspension beam (at top), the two vertical links, the spindle housing and the spindle form a parallelogram with overhung support at the crane hook, directly above the center of gravity of the entire machine. Thus the friction of the bearings and the inertia alone have to be overcome in shifting the riveting jaws from one point on the work to another; and two motors of two horsepower each are actually sufficient for the job! The tilting motion is limited to 30 degrees below the horizontal, but the rotation can be carried through the complete circle.



The world's largest portable riveter, whose design was necessitated by the turbine job for the Niagara power development

Wired Wireless Broadcasting

THERE was recently given the first demonstration of commercial wired wireless broadcasting, as applied to electric light wires on Staten Island, New York City. The studio is not unlike the usual radio studio. The output, instead of going to an aerial and ground connection, is delivered to the electric wires passing by the studio.

The wired wireless broadcasting company is planning an 18-hour daily program. Electric light users can subscribe for the service, in which case they are furnished with a compact receiving set which is attached to any electric light socket or outlet by means of the conventional plug. The lowest subscription rate provides for a crystal set and head-phones, while the highest rate provides for a loud-speaker set. If the Staten Island installation works out successfully, both technically and commercially, the idea will eventually be extended to other electric light systems.

Shifting Speeds With An Oil Pump

Some Details of a New British Variable-Speed Gear Without Gear-Wheels

By P. J. Risdon

ALTHOUGH this system of what may be termed "gearless gearing" has been in use for some years for such purposes as elevating naval guns and for the steering gear of ships, its application for other purposes has been restricted. At present, however, experiments are being conducted in England with a view to its application to automobiles. If these experiments are successful the outcome will be a revolution in the design of road vehicles. The subject is therefore of such great and direct interest to all car owners that we shall endeavor to treat it in as untechnical a manner as possible for the benefit of those who are not engineers.

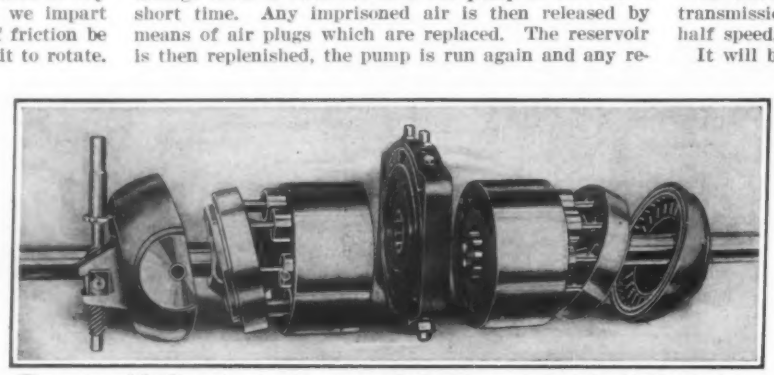
Supposing we have a vertical pin or hub on which a ball-bearing bicycle-wheel is mounted. If the wheel is horizontal there is no tendency for it to rotate, but if we tilt the assembly to a sufficient angle the mere weight of the tire valve will be sufficient to move the wheel round until at last it will stop with the valve at the bottom of the slope. Now suppose that there is no valve and that the wheel is perfectly balanced: if we then place a weight near the top of the slope, or impart a purely vertical pressure, the wheel will move round. More generally, if a pressure be imparted at right angles to the plane of a balanced wheel or disk in any position, no movement takes place, but if we impart the pressure *at an angle to its plane* and if friction be eliminated or reduced sufficiently, we cause it to rotate.

The gear that utilizes this principle comprises essentially two units. One of these consists of a special design of multi-cylinder pump for pumping oil. The other consists of one or more motors driven by oil delivered under pressure by the pump. The pump and motor may be placed at any convenient distance (within reasonable limits) from each other and at any angle or different height, and the two connected by a pair of pipes for the flow and return of oil. Alternatively the motor casing may be bolted direct to that of the pump casing so as to constitute a double unit, with the driving and the driven shaft in alinement. The only difference is that in cases where the two units are separated, there is a valve plate on one end of each, to which the ends of the two oil pipes are coupled. We describe the direct-connected type.

The pump is housed in an oil-tight case and comprises a thick solid cylinder called the "barrel" in which nine holes are bored concentrically so that it looks something like a large revolver barrel. The holes are not bored right through the barrel, but from the dead end of each a smaller hole is bored connecting the bigger holes with oval-shaped ports in the other end of the barrel. The barrel itself is keyed on the driving shaft and rotates with it. A set of pistons works in the cylindrical barrel holes and these pistons are coupled to what is known as a "socket ring" by connecting rods with cup and ball connections so as to allow of a certain amount of play, the necessity for which will be seen later. The pistons are hollow, and as the system is charged with oil constantly circulating under high pressure, the spherical bearings are always well lubricated. The socket ring is secured on the driving shaft by means of a universal joint, so that as the shaft rotates the socket ring rotates with it. The socket ring bears upon a set of circumferential rollers within a cup-shaped housing, the end thrust being taken by a separate set of conical thrust rollers. The housing is mounted inside the pump casing on a pair of trunnions, a vertical shaft and worm enabling the housing (and with it the socket ring) to be tilted to an angle of about one in two and one-half on either side of a plane normal to the shaft.

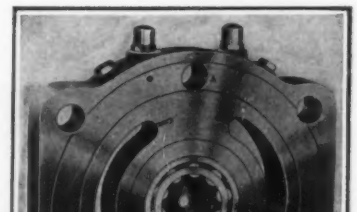
Between the pump and motor barrels is a gunmetal valve plate with a pair of curved ports right through it. The center of this valve plate is bored and bushed to receive two sets of roller bearings on the ends of the pump and motor shafts. A hole drilled through the valve plate enables oil to pass from the outer pump casing to the outer motor casing and vice versa, thus maintaining an equal supply of oil in each.

When charging the system, oil is admitted to the casings from a reservoir and the pump is run for a short time. Any imprisoned air is then released by means of air plugs which are replaced. The reservoir is then replenished, the pump is run again and any remaining air is released by air valves on the valve plate. The gear is then ready for work.



The gear with the outer casing removed, showing pump and motor complete

Let us now suppose the parts to be assembled within the casing, that the system is full of oil, that the pump shaft is coupled to a suitable prime mover such as an electric motor or an engine, and the oil-motor shaft to another shaft that has to be driven. It is important to remember that the pump and motor shafts are in no way connected, but are free to rotate at different speeds. If the pump socket ring be first adjusted by the worm so that it lies in a plane at right angles to the axis of the shaft, and the engine be then started and run at full speed, the socket ring and pump will merely rotate without any pumping actions taking place and consequently without affecting the motor at all, so that the motor shaft will remain stationary. But if we gradually tilt the pump socket ring in either direction it will be forced to rotate in the plane in which it lies by the housing containing it, the universal joints permitting of this. Consequently it will cause the pistons to move in and out of the barrel cylinders, so that during half a revolution oil will be pumped out of the cylinders, and during the other half revolution oil will be sucked into the same cylinders. The oil must necessarily pass through the valve plate ports to the motor, on the pistons of which it will produce a corresponding movement. But the motor socket ring being permanently set at an angle, when the pistons are forced out the pressure on the inclined ring causes it to rotate. Thus the oil constantly circulates between the pump and motor under hydraulic pressure and serves as the working fluid. The greater the tilt of the pump socket ring, the more rapid the flow of oil and the more rapidly the motor shaft rotates.



The valve plate between the pump and motor units

In a set of gear tested by the writer an electric motor was coupled to the pump shaft and run at a thousand revolutions a minute. The pump socket ring was then slightly tilted and the motor shaft ran at one revolution a minute. From that, by increasing the tilt, the motor shaft was speeded up to a thousand. The socket ring was then tilted in the other direction, the speed of the motor shaft gradually slackened down to zero, and the same procedure was gone through with in reverse.

An efficiency of 85 per cent is obtained at full-speed transmission. This efficiency drops slightly down to half speed, and then more rapidly at lower speeds.

It will be clear from what has been said that, if we couple the pump shaft to an engine shaft, and the motor shaft to any other shaft to be driven, the variable speed gear provides a neutral position and also enables any desired speed in either direction, from zero to medium speed, to be maintained, according to the load. It has already been explained that the pump and motor units may be placed in any convenient position and connected by a pair of oil pipes that virtually take the place of shafting. It is obvious then that the gear is eminently suitable for use with alternating electric motors for which elaborate means have to be provided to enable them gradually to take up the load. Again, it should often obviate the necessity for the totally enclosed type of electric motor, necessitated in certain cases by the fact that motors have to be coupled up to the machines they drive. With the variable speed gear the electric motor and pump can be placed in any convenient position and the oil motor in any exposed position desired.

Another of its uses is as a hydraulic pump. A suction pipe from a reservoir to the pump unit would keep it supplied and enable it to be used as a variable speed pump for hydraulic work generally, its output being automatically controlled if required.

But of all uses, its application to automobiles appeals to one most. Let us consider why. Firstly on an ordinary motor car we have the clutch—at best a crude apparatus. Secondly there is the gear box, with its arbitrary steps in speed, that requires skill and practice to manipulate properly and without nerve-racking noises as when the gears refuse to mesh under the hands of a beginner or an unskilful person. Thirdly there is the cardan shaft and a number of universal joints requiring frequent attention. Fourthly there is the cardan-shaft brake with its attendant levers. Finally there is the back-axle gearing and differential. What can be said of a device that will eliminate all the above-mentioned objectionable features in automobiles? For that is what their experiments lead the makers confidently to anticipate.

A pump unit will be coupled direct to the rear end of the engine shaft, a pair of motor units will be placed in alinement at the back axle, with oil pipes between them and the pump unit, and each oil-motor will drive its own wheel shaft. Instead of differ-

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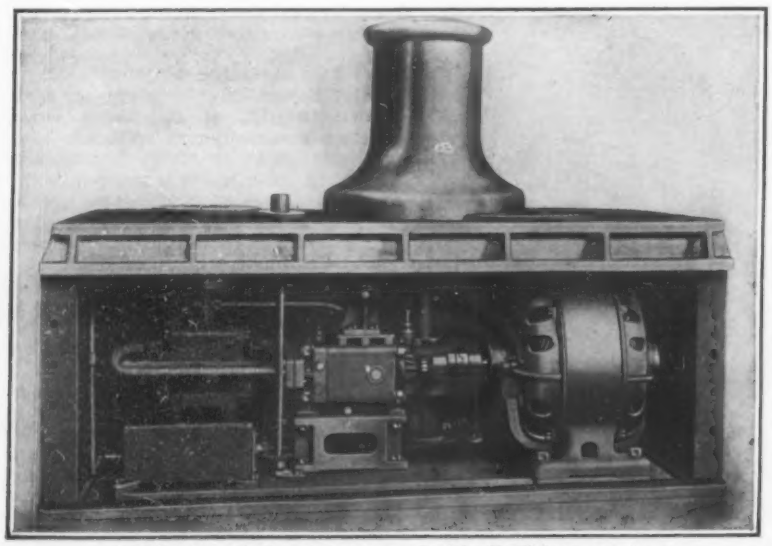
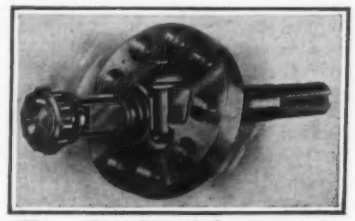


Application of the gear to an electrically-driven capstan



The socket ring of the new gear

Clever Contrivances of the Garage Man

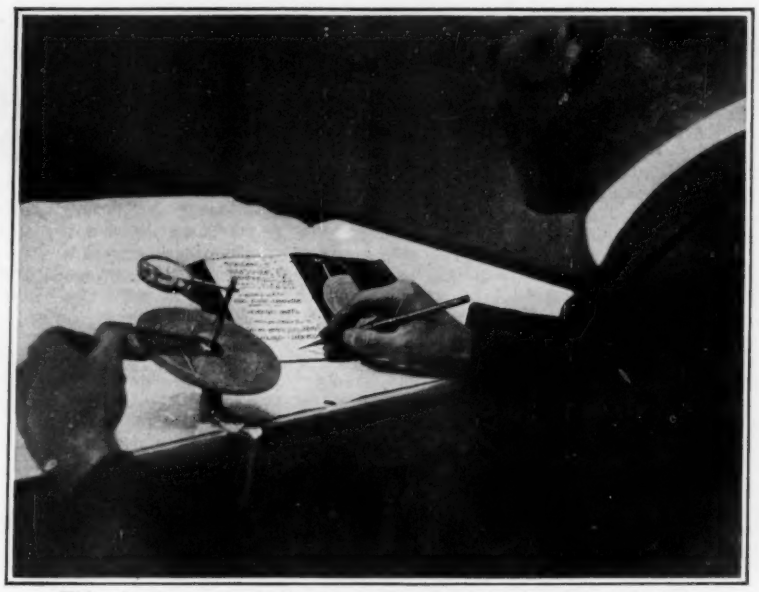
ALL specialized trades in which the machinist figures at all present scope for the inventor to provide special tools and fixtures for doing very special jobs in a fraction of the time that would be required were these tasks to be performed on standard lathes, drills, or other apparatus. In no other line has this tendency gone further than in automotive construction and repair work, and in no other are the devices of the sort suggested in wider or more general use. That the factory would have gone in rather heavily for this sort of thing is far from surprising; but that the garage repair-shop can and does afford such a variety of special equipment would be a surprise to one who had not clearly visualized the enormous saving in cost which enables a machine to pay for itself despite that it is used but once or twice a day.

A San Francisco garage was invaded by the SCIENTIFIC AMERICAN correspondent some time ago, and at least three machines found which earned the attention of the reportorial pen and the reportorial camera. The first member of the group below is a stand for testing and adjusting differentials. This clever outfit is so arranged that it gives information about the differential which, in its absence, could be got only by repeated road trials of the car, with dismounting and readjustment of the rear end between every two trips. At the right is seen the variable-speed motor that drives the differential undergoing test. At the extreme lower left is seen the foot-lever for the prony brake which applies a retarding force to one side of the differential, and enables the operator to watch the complicated gearing in action. Not alone in working economies, but in the absolute satisfaction with which differential adjustments may be made, this assembly is of extraordinary value.

Every owner has, at one time or another, had electric trouble of a nature requiring the testing out of one or more of the circuits on his car. Sometimes this has entailed an actual dismounting of portions of the car and carrying of them indoors to the testing apparatus; at the best it has involved a good deal of inconvenience in bringing the testing apparatus to the car. Here we have the better way. A battery is mounted in a wheeled box (the wheels may be just made out, where they peep from under the edge). In addition to the wheels, the box carries on its under side a cradle making it easy to set it down on the framework of the car, or anywhere else for that matter. The lead wires of the battery actually serve as "reins"; the mechanic drags the battery about by them, and in a jiffy he has it right at the spot where its aid is required to learn the electrical condition of the car.

The third view shows the portable tool racks which follow out more or less the same idea as does the portable battery. Each of these stands has three racks, enabling it to carry practically all the hand tools likely to be required on any repair job. They wheel about from place to place, so that the busy mechanic always has his tool kit at his elbow, and is able to dispense with repeated trips to the other side of the building to get them.

The same garage has a clever way of testing headlights for conformity with the law—which must be more strictly enforced in California than it is in the average eastern state, if any necessity is ever felt for checking up a car's compliance with it. On one end of the building have been painted a series of vertical and horizontal lines, with two dots. The vertical line is in the correct position for centering the automobile whose lights are under examination. The two dots are then in such place as to correspond to the exact centers of the lamps. The line on the floor marks the distance from the wall which the lamps should be for the test, and the horizontal mark on the wall indicates the dead-line above which no light from the lamp should fall. This is sufficiently clear without a photograph; and equally clear it is, that with the lines properly arranged the assurance may be had that any lamp meeting the above conditions meets the state law.



This circular computer is presented as an improvement upon the conventional slide-rule

A Circular Slide-Rule

ALL technical calculations require answers to an accuracy consistent with the data: 2, 3, 4, or in very fine work, 5 significant places. For this purpose the graphic-log method is by far the best. But the shrinkage and warpage of the ordinary wood-celluloid slide-rule, make it unreliable, while its scales require months to master. A new, all-metal, circular computer that utilizes the logarithmic principle, but is built like a transit or compass, and convertible for desk or pocket, has been recently perfected by Louis Ross, a civil engineer and ingenious inventor of San Francisco.

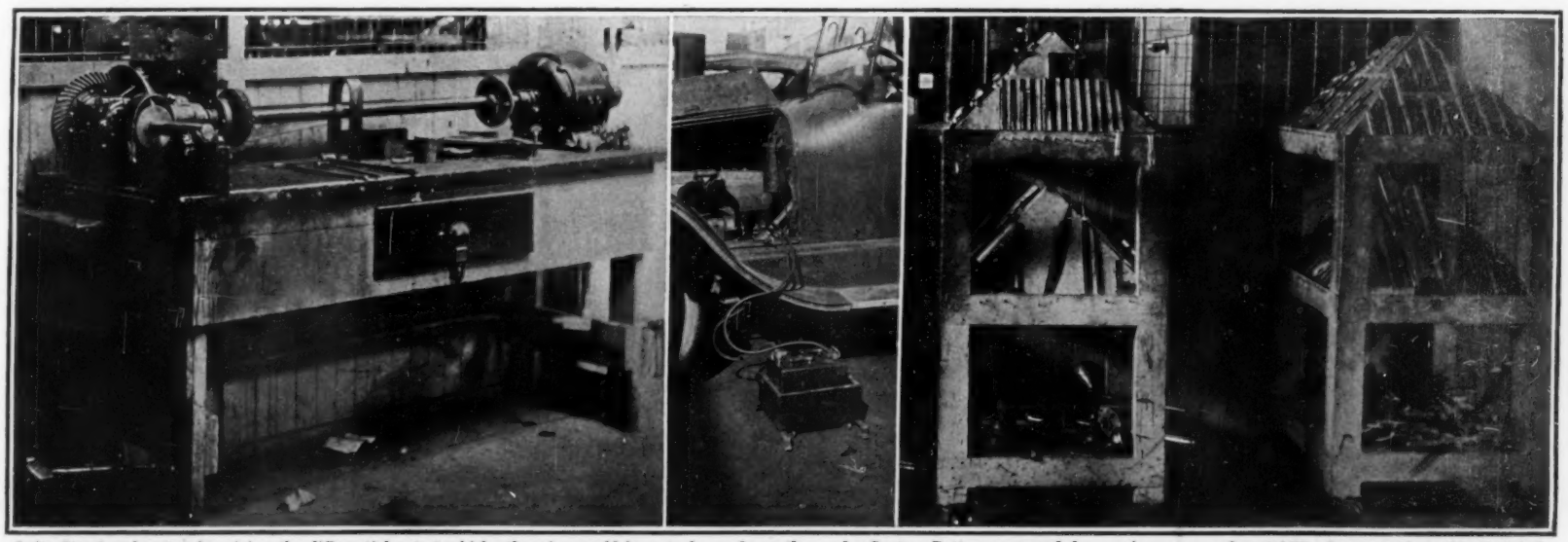
This computer is shown in the illustration. It consists of two scaled, rotating dials, read by a radial hair-line engraved under the lockable arm. The computer is five inches in diameter, while the inner dial is four inches, so that contact scales are 12½ inches long, like upper scales of a 25-inch straight rule. The outer and inner dials of the computer are analogous to the upper and lower movements of an engineer's transit; a thumb-lock, as on a transit, controls the outer dial; while a special desk-clamp serves, like a tripod for the transit or compass, to increase accuracy and convenience, and to permit one-hand operation, leaving other hand free for writing down results. Double readings, answer and proof, like the double verniers on a transit, eliminate mistakes and errors, instrumental and personal. The dials are graduated directly on heavy metal, fine as a transit, but in purple color easy to read and soft to the eye. Made wholly of metal, the computer is unaffected by heat, cold, dampness.

The magnifier, adjustable in focus, radius and direction, makes readings appear larger than ordinary typewriting, increasing accuracy of interpolations. When direct, less precise readings are desired, a touch of the finger turns the magnifier aside; and it is instantly detachable for separate use. The use of either magnifier or desk-clamp is optional, both are instantly detachable. The loose-leaf leather case, supplied with standards 3¾ x 6¾ sheets, in a variety of rulings and forms, folds to 5 x 7, so as to fit coat, breast or back pockets.

The key for operation is given on the arm, in plain sight of user. When any problem is set under the hair-line of the arm, a long arrow automatically points to the answer, while a short arrow shows the proof. If the problem involves three items, two knowns are set opposite each other, and opposite the third known the answer appears. Repeat numbers, or "constants," can be locked, so that they will not shift accidentally—a great convenience in heavy, tabular work. Trigonometric, logarithmic and exponential problems are solved just like plain numbers, by using the special scales as labelled on the arm, for that purpose.

Stave Trade in Foreign Countries

FOR the benefit of American cooperage exporters, the Lumber Division has just issued the publication "Stave Trade in Foreign Countries." This is a compilation of reports from American consuls and representatives of the Department of Commerce in various foreign countries. Being replies to a questionnaire sent out by the division, these reports cover the importation, domestic manufacture, specifications, and uses of cooperage, as well as indicate how the import trade is handled. In addition, statistics on the cooperage exports of the United States and imports and exports of other countries were prepared by the division. Statistics on United States exports for 1922, which were only recently available, have been added as an appendix.



Left: Stand and motor for giving the differential a test which otherwise would have to be made on the road. *Center:* Battery arranged for maximum ease of portability in connection with electrical tests of the car. *Right:* Insurance against time lost in going for tools

Some of the ingenious special fixtures with which the labor item is cut in the up-to-date garage

Fish as Food

How the Annual Catch of Over and O Disposed of as Fresh and Frozod, an

EVERYONE who has given any thought to the subject must have realized that the fishing industry of the United States was prosecuted on an enormous scale; but it will be news to many of them that the annual catch is over 2,600,000,000 pounds of fish. Analyzing the distribution of catch in millions of pounds, we find that the Middle Atlantic states stand far in the lead with a total catch of 864,000,000 pounds; followed by the New England states with 467,000,000; South Atlantic states, 333,000,000; Alaska, 312,000,000; Pacific coast states, 286,000,000; the Mississippi River division, 148,000,000; the Gulf states, 131,000,000; the Great Lakes with 104,000,000, and Lake of the Woods and Rainy Lake with over 2,000,000 pounds of fish.

An enumeration of the multitudinous craft and the diversified gear which are used in recovering this rich store of food from our seas, lakes and rivers would make a story in itself, and we must be content, just now, to state that the total tonnage of fishing vessels reaches the large figure of 69,555 tons; the total number of men employed is 200,000, and the cost of the equipment is $184,121,711. Our artist has endeavored to present this figure in concrete form by the accompanying picture, showing the 55,000-ton "Leviathan" with a typical Gloucester fisherman of nearly 70,000-tons displacement drawn in as a background.

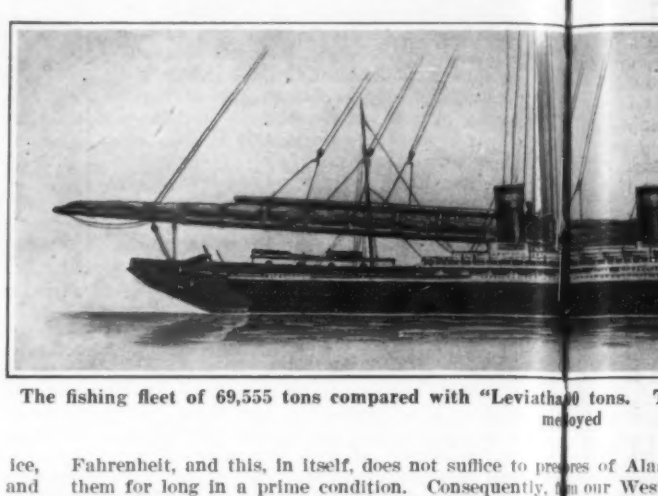
If you ask the average citizen what becomes of this great catch of fish, he would probably tell you that it is landed as quickly as possible, brought with all speed to the table, and eaten as fresh fish; but he would be altogether wrong, as a single glance at the accompanying drawing will show. As a matter of fact, just one-third of the total catch consists of fish known as the menhaden, which is so full of oil and of such a flavor as to be unsuitable for the table. It is eaten only in certain locations, and then only by the poorer people who cannot afford to pay for fish of a better quality. The menhaden is not caught on the Pacific coast; but it is found in supreme abundance off the Atlantic coast where the total catch, according to the latest figures, was 880,543,339 pounds. These fish travel largely in shoals, and are caught by seining and in traps. They are taken to various plants scattered along the coast, where they are cut up and the oil extracted, the residue being dried and ground to form the fertilizer of commerce.

The best known of the eatable fishes is shown on the accompanying engraving, in which the total catch in pounds and its total value is shown upon each specimen. These are the mackerel, halibut, cod and the weak fish; while the canned fishes shown are the salmon, sardines and the tuna fish. Our artist also shows the lobster, the crab and the oyster. The whole story relative to amount and values is so clearly presented as to need no other comment, further than to point to the enormous dimensions to which the canned salmon industry has grown, with its total canning of 161,643,360 pounds valued at $26,761,000.

We have spoken of the freezing of fish for food, and this is one of our rapidly expanding and vital industries. We must inevitably greatly amplify this business if we are to make the most of nature's well-nigh inexhaustible supply. The finny creatures are rich in nitrogen, which is essential to a well-balanced diet and, therefore, to our bodily fitness.

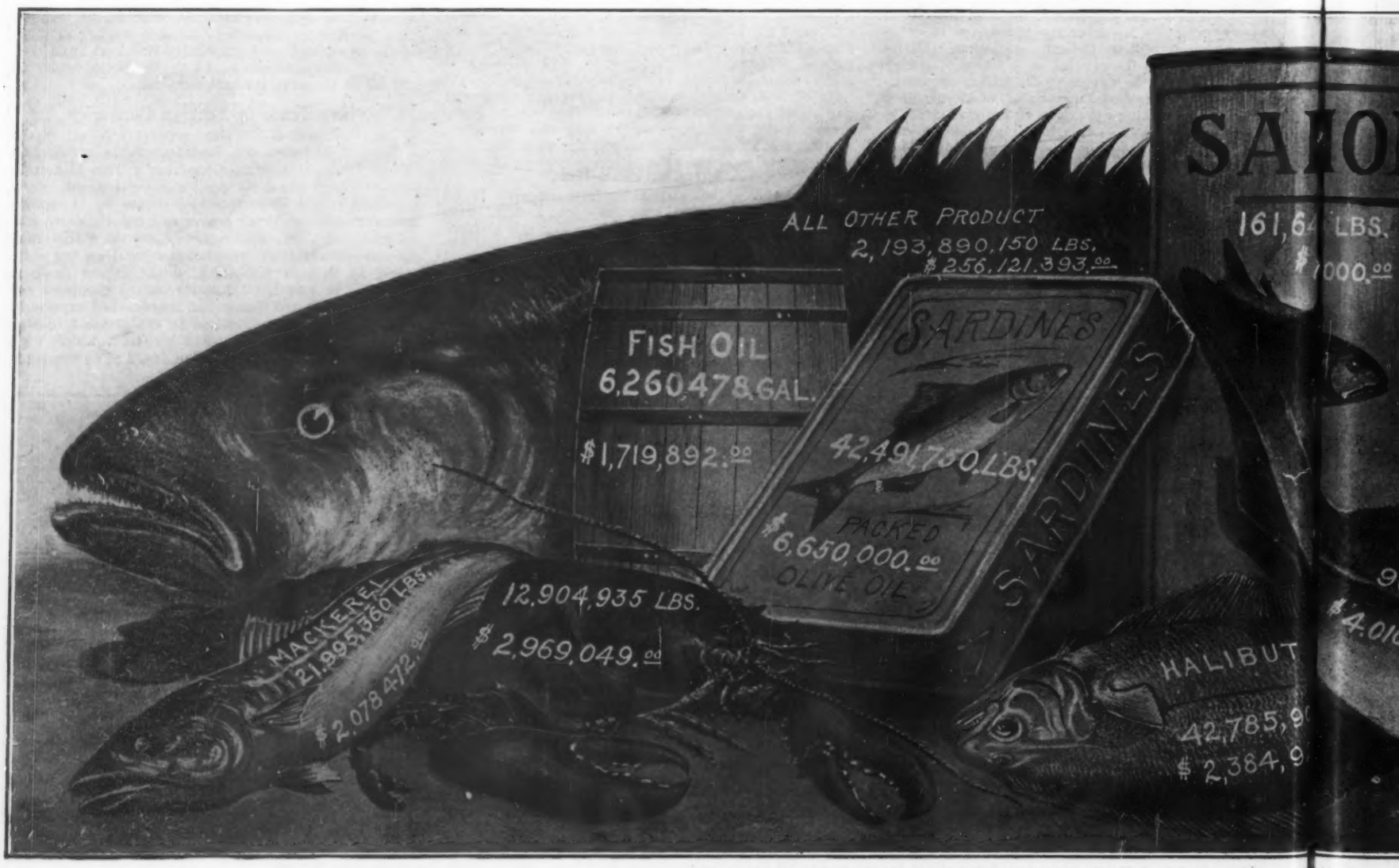
Our fishing fleets, as we have noted, have taken from our waters in the course of a year over 2,600,000,000 pounds of fish. Goodly measures of certain species are canned, smoked, salted or otherwise preserved; but the largest part of these catches is sold and consumed promptly, while a lesser but very important percentage is put away in cold storage where it is held for months. According to the latest statistics available, there were frozen in the United States in 1920, fully 85,324,366 pounds of fish, with halibut, herring and whiting heading the list of some forty-odd varieties.

As most of us are aware, fish can be packed in ice, provided plenty of ice at moderate cost is at hand, and they can be sent afar from shipping points and arrive unharmed and palatable if the weather is favorable. This has been done even in the summer time, when special precautions were taken; and fish have in this way been dispatched inland a distance of 800 miles without suff[ic]it may no deterioration. As a common thing, however, this proc[ess] om the wa is not resorted to during the warm months, except fo[r] rigerator tribution within a much more limited zone. Packing our land. in ice does not lower their temperature below 32 d[e]g of the f[re]



The fishing fleet of 69,555 tons compared with "Leviatha[n] 00 tons. 7 me[n] oyed

Fahrenheit, and this, in itself, does not suffice to pre[s]erves of Ala them for long in a prime condition. Consequently, [f]n our Wes ing is employed instead; and there are more than a[ ] Europe, v dred establishments in the United States now engage the fresh s this business, which does much towards lessening the [c]ity. Ther of living. [e] if the fre

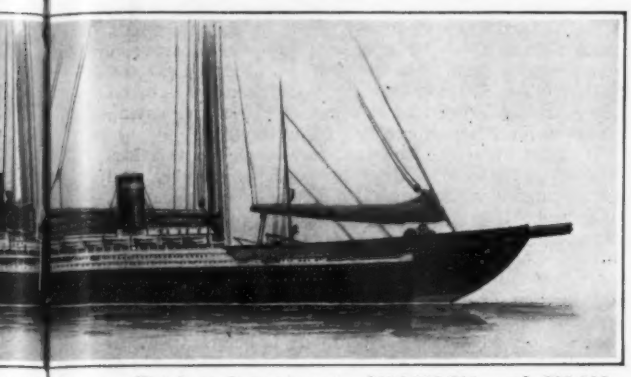


The annual catch of the leading varieties of fish in the United States. The total ,000,000 pou

ood Fertilizer

Over and One Half Billion Pounds Is Frozod, and Fertilizer for the Farms

t suff t may not be generally known that fish, when fresh proc m the water and promptly frozen, may be carried in ept fo frigerator cars anywhere within the length and breadth ncking our land. The best proof of this is that all but 10 per 32 de t of the fresh halibut consumed by us originates off the



viatha 0 tons. Total equipment costs $184,121,711, and 200,000 me oyed

o pre es of Alaska. Before the World War frozen salmon atly, fr m our West coast was eaten extensively even in West- han a Europe, where it sold readily at good prices. Much engage the fresh salmon for our tables comes from the same g the ity. There would not be the demand for this comes- e if the freezing of the fish rendered them flat in flavor and less desirable, judged by the standards of strictly fresh fish.

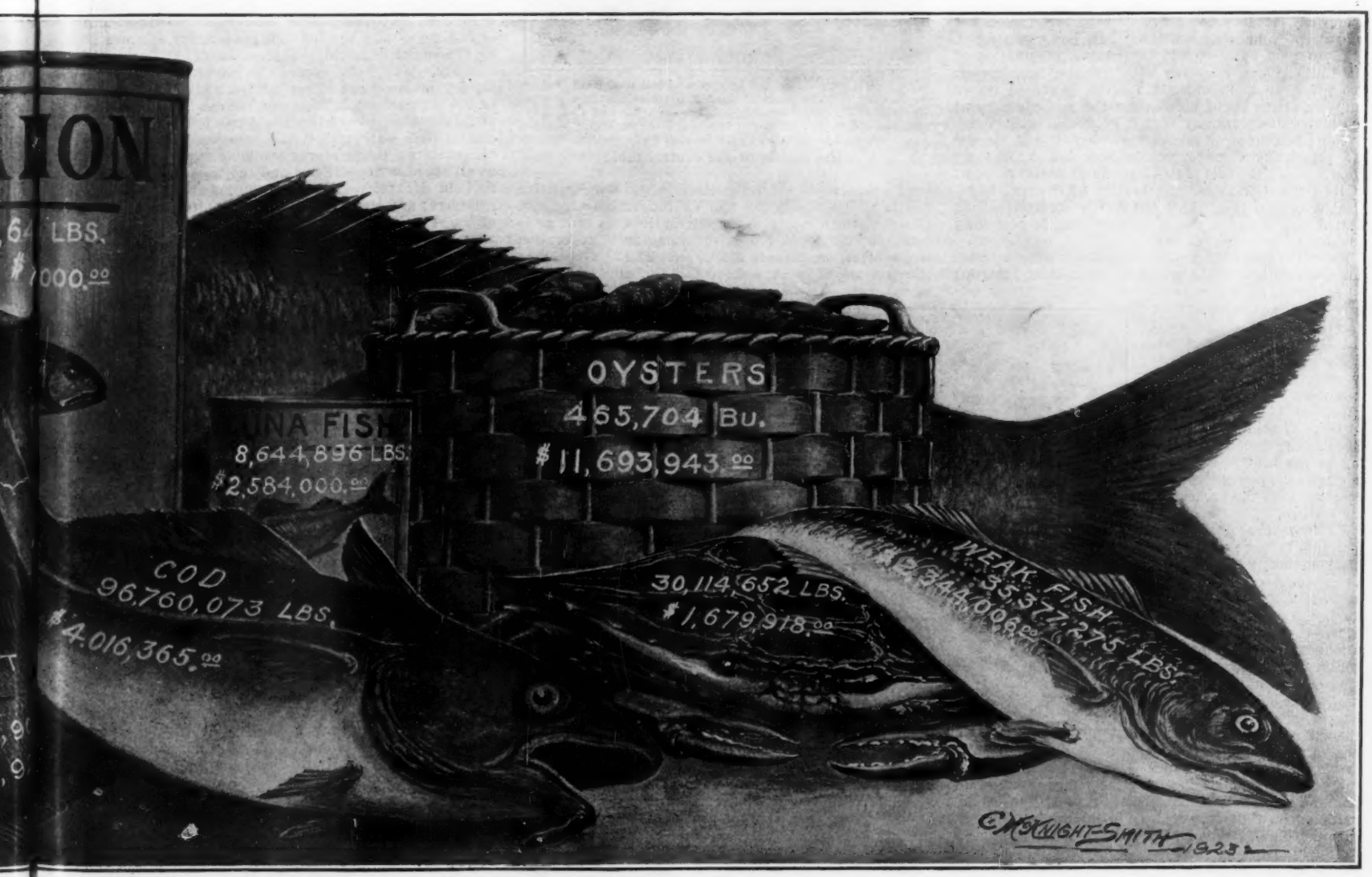
The process of freezing fish is an adaptation of artificial refrigeration designed to preserve an extremely perishable foodstuff, commonly taken from the waters in mild or warm weather, so that it may be at our disposal in the winter months especially, when fishermen cannot venture forth upon the stormy seas. It is also intended to permit the fisherman to reap a harvest when "the run is on," and to make it feasible during the days of plenty, to store away some of the abundance for consumption out of season.

As a rule, the frozen stock is carried in cold storage from six to twelve months, the greatest volume being disposed of within from six to eight months after freezing. However, the longest of these periods is relatively short when compared with certain tests conducted by the Federal authorities, which proved that frozen fish could be held for 27 months. At the end of that time, elaborate analyses of the fish failed to show that any changes had taken place which would render them at all unsuitable for food, or to indicate any important differences in chemical composition between these fish and fresh fish or fish stored for shorter intervals. As soon as a catch reaches the plant, the fish are washed with cold, running water to free them of dirt and slime. Next, depending upon the size of the fish, their nature, and the requirements of the market, they may be split and cleaned before undergoing freezing. Generally, fish that are heavy feeders, that eat freely of animal matter, or that are rich in oil, are eviscerated to insure their better keeping in cold storage. It is impracticable to gut such species as butterfish, bass, small mackerel, etc. These are usually frozen in their natural state after they have been put in pans capable of holding about 40 pounds of the foodstuff. Ordinarily, a pan contains a single layer of fish, placed spoonfashion, head to tail, and when the pan is filled it is set upon the shelf of what is known as a "sharp freezer." The temperature of the room ranges between 5 degrees to 15 degrees below zero Fahrenheit. The fish remain on the shelf only long enough to freeze them through and through, and the quicker this is done the more palatable the fish in the end. Rapid freezing is, therefore, preferable.

Large fish, like halibut, salmon, black cod, are seldom handled in pans, but, after washing, are laid right on the shelves of the sharp freezer and are frozen separately. They are then as hard and solid as stone. Whether panned or frozen singly, fish require anywhere from 6 to 24 hours to put them in the desired condition. A thick fish, naturally, takes longer to freeze through than a thinner one.

The next step in the process of preservation consists in giving the fish an icy coat or glaze, and the manner in which this is done is of importance. Glazing is designed to encase each large fish or each block of frozen small fish within an airtight envelope of clear ice. Unless so glazed, the skins of frozen fish are liable to turn white while the bodies shrivel, owing to loss of moisture induced by evaporation even at freezing temperatures. Glazing prevents the evaporation of the moisture from the flesh of the fish; prevents the entrance of air which tends to make the fish oils deteriorate; provides an ice surface upon which molds and fungi cannot grow, and, finally, helps to protect the fish from mechanical injuries.

The temperature of the glazing room is in the neighborhood of 20 to 25 degrees Fahrenheit. On reaching this room, the frozen fish are put quickly through a trough of clean, clear water which is at or near the freezing point. This water forms a thin film which solidifies well-nigh instantly in the cold air of the room. By passing the fish through the water from three to five times, this protective coating is built up until it constitutes a sufficiently heavy veneer of ice which covers the entire surface. In the case of the canned fish, during glazing and before the accumulating ice has gripped the fish in a solid cake, the fishes are held together by the freezing of the first thin layer of water between them; and the additional glazing still further cements them to each other, thus guarding them against any movement during subsequent handling which would be apt to damage them. From the glazing room the first go ultimately to cold storage.



total ,000,000 pounds. Its value is $84,401,184. Its cost to the consumer is $211,002,960

Feeding the Automobile Engine

Purdue University Investigation of the Proper Treatment of Mixture that Goes to Carburetor

THE FUEL problem is no longer merely that of finding a supply of light combustible hydrocarbons; it is that of an insured supply of any liquid fuel at a proper price. The public has ceased to ask for light and volatile fuels, and is asking merely ordinary combustibility and a reasonable cost.

We are told that we have in sight only a ten-year supply of gasoline. The situation is not quite so desperate as this, for we shall undoubtedly develop new sources and new fuels. But in view of all the known factors, it is necessary to conserve fuel and to utilize fuel with a minimum of wastage.

Car, truck and tractor must today use the heavier fuels and leave the lighter ones for the plane. These heavy fuels grow heavier each year; they continue to burn in our cars, but with a long tale of low efficiency, excessive repairs and maintenance, and short life. We sometimes ask whether the Otto cycle is permanently suited to the fuels of today and tomorrow.

The Otto cycle may ultimately be replaced, but for the present it is the one in universal automotive use. The immediate attack upon the fuel problem lies in the practical use of all available data regarding fuel combustion. Formerly the light fuels required no heat beyond the sensible heat of the intake air. Today, even with decreased manifold pressures the atmospheric temperature is inadequate and heat must be added. Much hinges about the best way of effecting this addition; six different procedures may be identified.

Preheating the fuel for the sake of a dry mixture is useless; it interferes with metering at the nozzle. Moreover, what is needed is the heat equivalent of vaporization, after the boiling point is reached; and in no event can we raise the temperature of the fuel above the boiling point of its highest fraction.

Preheating the air is very useful on the cars now in operation. It does not interfere with carburetion but cuts down volumetric efficiency and power delivered. It gives good mileage, smooth running, elimination of oil dilution, lean mixtures with freedom from carbon deposit. The main objection is the decreased power output and the slight decrease in thermal efficiency at the higher temperatures.

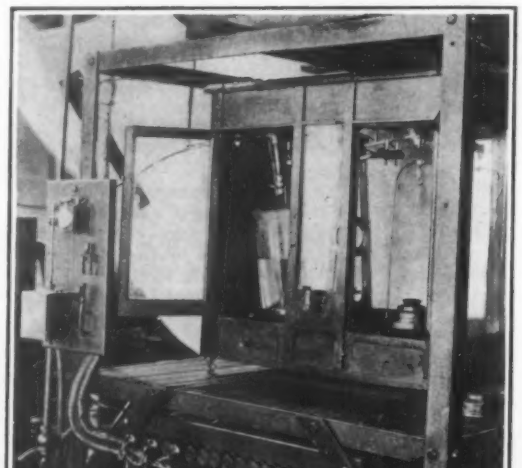
The advantages of *preheating the fuel and the air* are principally those derivable from heating the air alone. Again the fuel must stay below the boiling point of its lightest fraction. No heating of the fuel is advisable, beyond that which necessarily occurs from the heated air, unless a device is used that is peculiarly adapted to metering control.

From the theoretical viewpoint, *heating the mixture* has advantages over the preheated-air method. Heating is achieved at lower pressures, and the degree of heat may be more variable without affecting the carburetor. If the minimum temperature is sufficient for idling, the maximum will not cause bad effects at higher loads and speeds. If skill is not exercised in the design and placing of the heating surfaces, however, the power loss is as great as with the preheated-air method.

Heating the fuel after metering is more nearly the ideal method, possessing the good points of heating the mixture and being free of the bad features of the other ones. Having been metered, the fuel may be completely vaporized if necessary. The temperature of the vaporizing surfaces, when exhaust heat is used, never ignites the fuel. The air is barely heated at all, while the fuel is wholly vaporized. When the two are brought together, the temperature of the final mixture approximates closely to the theoretical minimum; so the power loss is insignificant. Again care must be exercised in design; and wet portions of the fuel must be allowed to pass through the separating device or acceleration will be accomplished only with a lag.

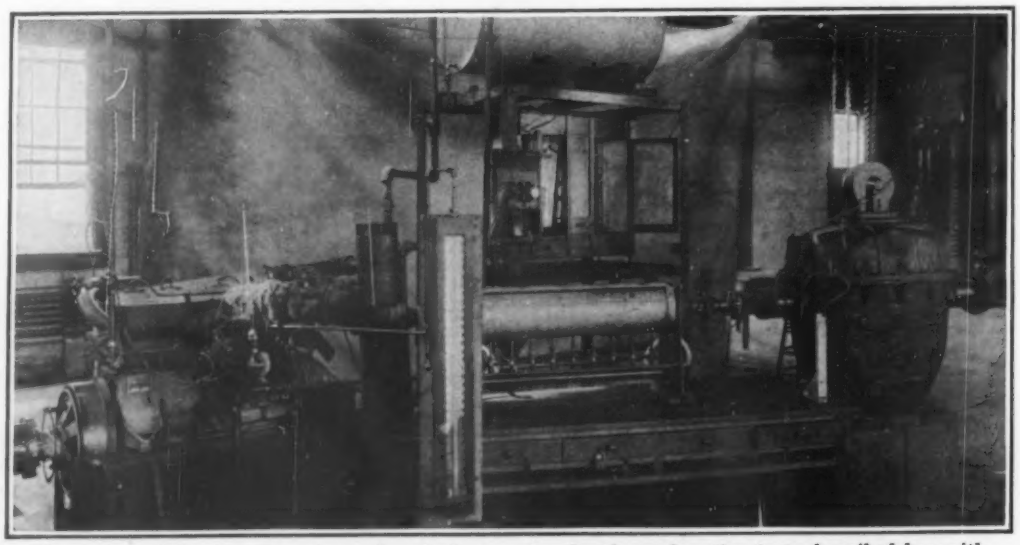
Heating the fuel and part of the air after metering is a modification now in use in some cases. The final temperature of the mixture may be quite low without excessive deposition. A very delicate metering device must be used, however, and as vaporization is entirely from the heated walls of the hot area, the temperature of these must be very high.

The Engineering Experiment Station of Purdue University has made extensive tests to show the relative merits of preheated air and of the various hot-spot methods which comprise the alternatives, as well as to bring out all possible data regarding fuel preparation and combustion, fuel-air ratios, etc. The accompanying illustrations show in some detail the apparatus used in these tests. The engine was direct-connected to an electric cradle dynamometer through a suitable universal joint. Means were provided for measuring all temperatures, pressures, etc.; and all tests which were to be compared in any series were made with the same throttle opening and load. In testing the "hot-spot" operations the hot spot was of experimental design, heating at the outside bend of an enlarged intake pipe. An inspection glass of ample diameter was placed at the top of this section, so that the spot could be easily observed, and the dryness of the mixture and the size of the fuel globules noted.



The fuel is weighed on the balance and siphoned from beaker to carburetor. The panel at the left provides electrical means for controlling measurement of speed, time, air and fuel. The switchboard at the bottom provides means for regulating voltage from 2 to 32 volts, giving flexibility of operation

The details of the control table



The engine, air-heater, air-meter and control apparatus for the carburetion tests described herewith

In general terms, these tests showed that with suitable attention to the best operation of our automobiles and trucks, at least 25 per cent of the fuel used in the automotive industry could be conserved. This would come to 1,362,500,000 gallons, worth, at current prices, some $300,000,000. This estimate is conservative; it represents the minimum saving which might be effected with the vehicles now in use. With accurate data on the numbers, types and weights of these, the saving would no doubt work out at a higher figure.

It is not alone the fuel that is wasted, but this loss indirectly leads to other complications. Poorly and partly burned fuel causes oil dilution, excessive carbon, and hence high upkeep and high depreciation. The unnecessary charge under these headings for the entire United States is at least a billion dollars annually. Applying the results of these tests to individual cars, substitution of correct for incorrect operation has in numerous specific cases increased gasoline-mileage anywhere from 40 to 250 per cent. It is believed that at least half of the cars now operating are susceptible of material improvement in fuel utilization.

In support of their conclusions that the hot-spot method affords the best prospect of meeting future conditions, the Iowa engineers refer to the fact that while much has been published concerning the power losses due to excessive heating of the charge in a vaporizing manifold, less attention has been diverted to the fact that as much or more power loss is possible from the decrease in volumetric efficiency that follows from poor selection of heating surfaces and unfavorable temperature of these surfaces. With the very crude experimental hot-spot used in the tests, a metal temperature of 590 degrees at the hot-spot gave a dry mixture at half load with an intake pressure of 11 inches of mercury. Why, then, cannot the performance be satisfactory at low-speed idling with a metal temperature of 300 degrees and 20 inches of vacuum? The problem of manifold design resolves itself into the one of fundamental data on rates of fuel vaporization at various temperatures, temperatures available from the exhaust at all operating conditions, and the vaporization of the fuel in its relation to distribution to the several cylinders; and the utilization of ingenuity in the design of the vaporizing surfaces. If more analytical methods were substituted for the out-and-try procedure so largely in use heretofore, some of these problems would not assume such large proportions.

Engineers concede that the fuel of the future will be heavier than that of today. This granted, the statement can be made that manifolds will satisfactorily vaporize and distribute the mixture as well as is done today, or better. The big handicap now and in the future is starting. When a starting device is used that will immediately deliver the mixture sufficiently dry to the cylinder, no apprehension need be felt with regard to the good performance of the engine after it is warmed.

Street Lighting

THE Bureau of Standards is making a study of the various systems of street lighting used in cities and towns throughout the country. Seven hundred and forty-four municipalities have been asked for copies of their street-lighting contracts, and 102 replies have been received so far. About 200 replies have been received on street-lighting questionnaires which were recently sent out, and very full engineering data has been obtained from 30 of the larger companies. The text of a number of the general sections of a circular on street-lighting service has been prepared in preliminary form.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

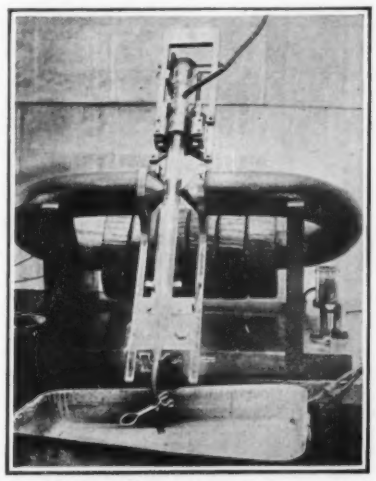
This attachment to the knife enables the hostess to serve the cake in complete safety

A Novel Cake-Server

INVENTION has come to the rescue of the host or hostess whose lot it is to cut and serve the layer cake. No special tool for this purpose is offered, but rather an attachment for the ordinary knife. This attachment, much like a two-tined fork in general outline, slips around the handle of a regular dinner knife. When the cake has been cut, the knife is slipped under it, and the fork pushed into the cake, holding it securely on the knife blade.

Oxidized Kerosene as Truck Fuel

THE solution of still another industrial problem has been undertaken at the research laboratories of Carnegie Institute of Technology, Pittsburgh, in experiments to determine the relative efficiency of kerosenes and oxidized kerosenes as fuels. In accordance with the policy of the institute to link up its educational facilities with modern industry, the Department of Chemical Engineering has been conducting a series of tests to determine the relative merits of various oils as usable fuels. The completion of this important work should go a long way toward solving the problem of oil conservation by the possible development of a new fuel. According to a report by Dr. J. H. James, head of the department conducting the experiments, oxidized kerosenes cause less "knocking" tendencies than straight kerosene when used in a kerosene engine. The tests also showed that oxidized kerosenes have approximately the same power development as ordinary kerosene in spite of the fact that their thermal value is one-eighth less. Dr. James attributes the efficiency of the oxidized kerosenes to the better "clean up" in the combustion of these partially oxidized fuels. The success of the experimental work at Carnegie at this stage gives promise that oxidized kerosene, which is manufactured by catalytic oxidation from low-grade petroleum, may become a useful fuel in the future. Its properties may cause it to be used industrially in kerosene engines or blended with gasoline for use in gasoline engines. Although it has a somewhat lower fuel value than ordinary kerosene, one of the most favorable features of its effectiveness is that it undergoes much better combustion in the internal-combustion engine.



Device for determining the amount of magnetic ore in concentrate

A Heat Economy

NONE of the advances of recent years in the manufacture of cement is of greater importance or interest than the utilization of the hot gases escaping from the kilns to heat the boilers that supply steam for the operation of the cement-plant power-house. For years an immense amount of energy was lost in these gases, which reached the stack at temperatures of ten to fourteen hundred degrees Fahrenheit in plants using the dry process of manufacture.

Many problems stood in the way of utilizing this heat, but great progress has been made, with the result that a number of plants are now producing from 50 to 100 per cent of their power requirements through waste-heat boilers. Such installations require heavy expenditures, but the adoption of this means of saving fuel will undoubtedly become more general as time goes on.

These waste gases consist largely of nitrogen from the air that furnished oxygen for combustion in the kilns, and of carbon dioxide driven out of the limestone during the burning. In plants employing the wet process, waste-heat boilers have been installed and have resulted in important savings.

Magnetic Assaying

THIS device is used for quickly reducing a sample of ore so that the magnetic iron percentage can be accurately computed. A sample of ore is placed in the glass tube which has been previously filled with water. The carriage and tube are then automatically rocked, the carriage bearings being placed at the poles of the magnet. A stream of water passes through the tube, washing away the tailings from the concentrate, which is held at the poles. When the washing is completed, the magnetic assay is made.

The Latest Auto Lock

HEREWITH is illustrated one of the latest devices for defeating the automobile thief. It consists, as the picture indicates, in a simple lock that is attached to the steering column, beneath the wheel. When locked, two plungers project upward and firmly hold a spoke of the steering wheel between them. Lock and plungers are of drop-forged, case-hardened steel, heavily nickeled; the lock itself is a cylinder affair of the familiar model. The lock is so constructed that it will not rattle, and there is no danger of its falling into locked position while the car is running.

A Magnetometric Method of Determinating Carbon in Steel

AN interesting account of a magnetometric method for determining carbon in steel was presented by Gunnar Malmberg at the recent annual meeting of the Swedish Metallographic Society. The new method is based on the fact that the magnetic properties of steel undergo a striking change as the percentage of carbon is altered. Though even other components of the alloy exert an effect of their own, this is, as a rule, incomparably smaller and, accordingly, does not greatly affect results. Moreover, inasmuch as Mr. Malmberg has accurately studied this effect, it is readily accounted for. An apparatus designed by the experimenter and known as carbometer enables this method to be applied to the testing of steel samples in actual practice and, being both rapid and reliable in working, has been adopted by some of the leading Swedish iron works for checking the progress of steel refining.

Soldering Without a Soldering Iron

SOLDERING without the use of a "copper" produces neat and rapid results, says *Sheet Metal Worker*. The method is to heat the parts to be soldered, by means of a torch flame, until they are just hot enough to "sweat" in the solder and not hot enough to make the solder run off. The ability to get the correct temperature comes with practice. A small, compact flame is best. Wire solder is employed, with the usual flux, and an acid brush. The surface to be soldered should be kept horizontal.

If gobs of solder form, they may be wiped smooth with the acid brush and the surface heated again, but when skill is acquired, the brush can be dispensed with altogether. No wiping cloth is needed. The only drawback to the method is that considerable practice is necessary to become skilled with it. However, not only is it much more rapid than the usual way of soldering with an "iron," but for some kinds of work the results are much more desirable. It is particularly effective where smooth soldering is wanted, as for example in the gasoline tanks of automobile touring cars, but where it would not be advisable to file off the surplus solder because by doing so you would be very apt to scratch the surface of the metal itself.

By means of projecting plungers that engage a spoke of the wheel, this lock makes the car secure

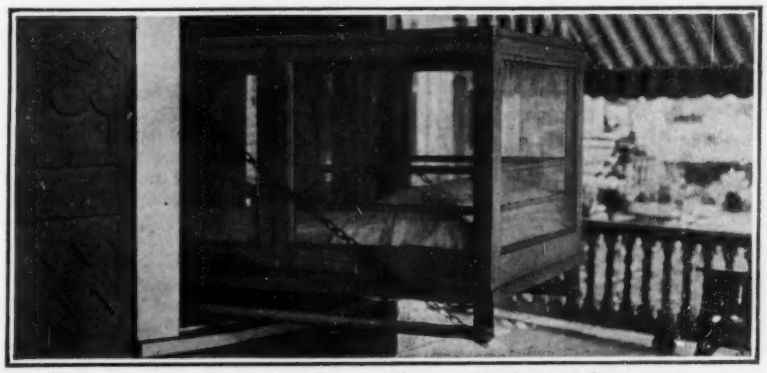
Wood Poles for Transmission Lines

A GERMAN firm has lately put on the market a type of wood pole, which should have a life of at least 40 years. The upper portion is of the usual kind, while the base is of impregnated hard wood. Experience shows that impregnated beech-wood sleepers have a life exceeding 37 years; and as poles are not subjected to the same mechanical shocks, the makers anticipate a longer life than this for their poles. The two portions of the pole are bound together by wrought-iron strips, which are bolted together.

The Window Bed

NO longer is it necessary to provide an expensive sleeping-porch for the benefit of those who need fresh air at night.

The window bed here illustrated can be rolled out of any window, with perfect safety. It is in reality a completely screened cot, mounted on a metal frame and supported from the floor much as



Sleeping out of doors without a sleeping porch

The simplified lawn-mower

small iron beds are supported. When rolled on its frame out of the window, it is held in place by chains. For camping the bed-like frame is not used, the springs resting upon the supports that hold them to the frame of the house. Under such circumstances, the sleeper is about six inches from the ground.

Keeping the Kitchen Range Bright and Shiny

POLISHING the kitchen range is not so essential as keeping it oiled against the invasion of rust. This fountain brush cleans and oils at the same time, the flow of oil being adjustable from the oil container which is in the top of the holder. A slight pressure of the thumb on the plunger, as illustrated, gives regulation to the precise amount of oil desired.

Funnel, Filter and Dipper in One

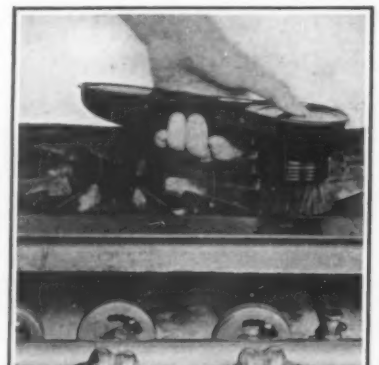
THREE kitchen utilities in one is the convenience now offered the housekeeper whose space is limited. Funnel, filter and dipper are consolidated into a single tool, illustrated, doing duty as a funnel. For conversion into filter or dipper, the circular attachments are used which in the photograph are shown leaning against the bottle. Two of these are of wire screening, one coarse-meshed and one fine; when placed at the entrance to the tapering part of the funnel, they obviously convert it into a filter. And when it is to be used as a dipper, the solid plug is used in their stead; and the contents of the bowl, instead of running through, stay in.

The insertion of one of the circular plugs converts this funnel into a filter or a dipper

A Simple and More Compact Lawn-Mower

A GREATLY simplified lawn-mower has been recently introduced by a Michigan manufacturer. It is claimed that the device cuts and trims both tall and short grass at the same time. It is lighter in construction than the average lawn-mower, weighing only seven pounds. Because of the fact that there are no large wheels at the side, it is possible to cut grass around trees, shrubbery and along embankments much better than formerly and this eliminates the necessity of hand cutting and trimming.

The mower drives in much the same manner as other types, having a long T-shaped handle which is solidly set. The cutters consist of sixteen small, gear-shaped wheels, but sharpened. Eight cutters on a side interlock and insure that the grass is cut evenly wherever



Convenient device for cleaning and oiling the kitchen range

the mower is guided. The cutters are adjustable so that the grass may be cut to any desired height. At the sides are two small wheels, only two inches in diameter. These serve to guide the mower and take the place of the larger wheels used on other types of mowers. These wheels have geared tooth edges which secure a hold for the mower in the dirt. Just in front of the wheels are two guards with pointed ends which serve to guide the operator of the mower and insure that it will be held at just the right angle to get the best results. The cutters do not need resharpening, but can be replaced at a small cost.

Solving a Printing Problem in the Composing Room

TYPICAL of a certain printing problem that often arises is the conventional check book of large size, with three checks on a page. It has always given the printer the option of setting up the check three times, or of printing three impressions upon the sheet, one after another, from the single plate. The first alternative is obviously an expensive one, the second introduces the further complication of getting the second and third impressions in exact register.

A blind inventor of Fort Worth, Tex., K. J. Dollahite, has steered a successful course between Scylla and Charybdis. He has designed a compound "chase"—this word, we should explain to the uninitiate, standing for the metal frame in which the compositor locks his type before sending it to the press. Mr. Dollahite's chase consists of an outer frame and an inner one. The outer chase serves merely as a track for the inner one to move in. The inner one carries the type, which is set but once for the three (or more) impressions. The inner chase is mounted in the outer one by micrometer screws, so pitched that one complete turn corresponds to a spacing of one pica. Thus it becomes possible, after a single impression has been run off with the inner chase in its upper position, to screw it down to an intermediate position and run the sheets through again for the second check, without a thought for the problem of register, which is now solved automatically. And in the same way, the inner chase is screwed down all the way for the third and bottom-most impression.

We have described its operation only for the case where three identical printings are to be made; but obviously the chase can be built for any desired number.

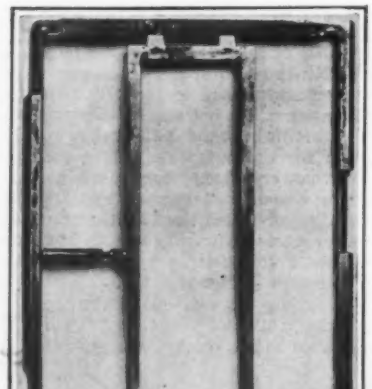
The Circular Washboard

KITCHENETTE housekeeping is brought one step nearer the ultimate goal of simplicity by the washing outfit illustrated. The washboard is made circular in section, and a pail supplied of corresponding radius. For washing the two are fitted together as in our illustration; for storage or packing they are left that way; and when the bucket is needed as a bucket, the washboard comes out. With the aid of this combination and a chair, one washes with convenience equivalent to that given by the stationary washtub.

Photography Makes Charred Manuscript Legible

AN important discovery, which practically solves the problem of restoring written or printed records made illegible by the carbonizing effect of heat under partial exclusion of air, has recently been made by M. R. Davis, one of the research workers of the Bureau of Weights and Measures in Washington D. C.

Handwritten, typewritten and printed



The adjustable, three-positioned chase that cuts the cost of printing checks, three on a page

sheets of paper were used in the experiments. They were subjected to conditions similar to those to which documents enclosed in fireproof safes are exposed during a big fire. Enclosed in a nearly airtight container of fireproof material, these papers were subjected to a high temperature, until they were carbonized. When removed from the container, the papers were completely charred and neither the writing nor the printing could be deciphered.

Mr. Davis, placing one of the carbonized sheets between two photographic plates and leaving them undisturbed in darkness for two weeks, obtained clear and perfectly legible negatives of the writing and printing on both sides of the paper. Both plates showed strong impressions of the writing on the sides of the paper with which they had been in direct contact and, very faintly, traces of the

A space-conserving wash-day combination for the crowded apartment

writing on the reverse side. Rapid and medium plates gave the best results, while slow plates gave poor results.

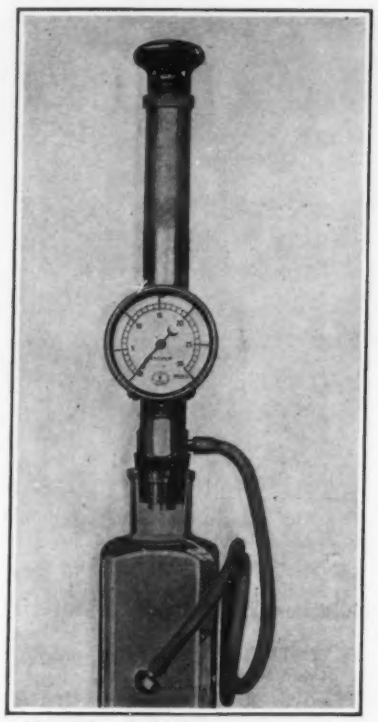
When rapid films were used instead of plates, the results were even more satisfactory. Excellent reproductions were obtained after an exposure in the darkroom for eight days. Strange to say, the writing and printing appeared on the films black, like a positive. It was learned that, with films also, negatives could be obtained, if before exposure, the carbonized sheets were carefully washed with distilled water and dried.

It is believed that the effect on the sensitive coating of the plates or films is due to the gases occluded in the carbonized paper and that the written or printed characters on the paper appear in negative because the ink acts as a screen, preventing the reducing gases from acting on the silver emulsion.

The Flashlight Goggles

CONVENTIONAL flashlights are all open to the objection that the user must give up one hand to holding the flash, or else must rig up a temporary base for the light when the job to be done is essentially a two-handed one. This is not particularly satisfactory, since the light remains fixed upon a single point instead of following the work as it should. A very clever escape from this predicament is seen in the flashlight illustrated, attached to a pair of goggles. The lamp is between the lenses, where it is out of the line of vision; and a shield is provided to protect the eyes from the light. Electric energy is supplied from a battery, not immediately attached to the lamp, but in the user's pocket and joined by wire to the lamp. Obviously, the light must shine upon the precise point at which the wearer's gaze is directed.

The flashlight that must shine upon the place where the worker is looking



Novel hand-power vacuum pump

A Gas Mask for the Miner

GAS MASKS have been used in several of the industries since the example of the World War taught some four millions of Americans their efficacy against poison gases. Firemen are now regularly equipped with them. Now comes one for the miner, called the "Self-Rescuer." Obviously, it is not the exact model used in the trenches. The miner has no need of one so elaborate and cannot be bothered with one so clumsy. But a manufacturer in Pittsburgh has put on the market a small though efficient mask that may be carried on the belt of the workman and which will not get in his way or be so bothersome that he will neglect to carry it. Ex-service men will smilingly recognize the old mouthpiece of rubber to which is attached by a string the same old nose clothespin that held the sides of the nostrils together four seconds after someone shouted, "Gas!" The rest is new. The little 13-ounce canister measures only four and a quarter by three and a quarter by one and one-half inches and is filled with a chemical known as Hopcalite. This chemical converts the deadly poison carbon monoxide known to miners as "afterdamp" into carbon dioxide, which is the same non-poisonous gas that puts the fizz in soda-water.

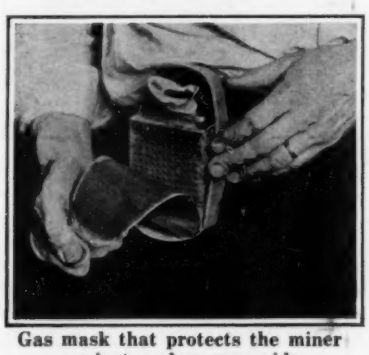
The engine thermostat that rings a warning bell

Since the necessity of using the Self-Rescuer in a mine may come but once in a lifetime, it was necessary to provide a method of protecting the canister against dirt and abrasion while worn during very lengthy periods of time. Accordingly, the mask is covered with a seal of metal which may be ripped off very easily as it is attached only with soft solder. The chemicals protect against any concentration of carbon monoxide that is likely to be encountered during a period of 30 to 70 minutes.

Vacuum by Hand

FOR small work, the hand vacuum pump illustrated, which has just been put on the market, affords a very economical substitute for a power pump. In addition to the standard and recognized uses for such an outfit by chemists, doctors, dentists, etc., the manufacturer suggests other fields in which it would give good service. Thus, it has been found possible to line iron pipe with lead by inserting the end of the pipe in molten lead and applying a moderate vacuum to the other end. The suction fills the pipe with the hot lead, and the latter cools where it is in contact with the iron. When the vacuum is released, the molten core flows back into the crucible, leaving the pipe nicely lined with lead. The procedure would, of course, not be available for a long pipe length, but would do very nicely for a short one.

Another application lies in the exhausting of liquids from inaccessible places—of water from a steam trap, etc. The pump is practically designed with reference to this sort of thing. The vacuum is created first in a glass bottle, and carried from this out along the line. Anything in the way of liquids that the suction brings home will enter the bottle rather than the pump, and will stay there until the bottle is filled; hence the apparatus may actually be used to exhaust acids. The pump is supplied both with and without the gage.



Gas mask that protects the miner against carbon monoxide

A Bell Motometer

THE standard motometer with its red line and its dead line above which the red must not go, is a great saver of repair bills for the careless driver. But it does have to be watched, and it therefore leaves something to be done in the way of giving automatic warning of an overheated engine. The bell attachment for the radiator cap which we show takes the additional step. Wound by hand as shown on the illustrations, the bell acts as a thermostat; the spring is released when a certain temperature is released, and only a totally deaf chauffeur has any excuse for not knowing that trouble awaits him if he doesn't stop and investigate.

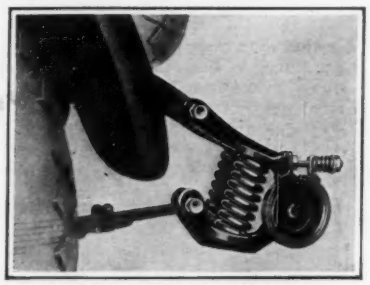
Carrier Current Makes Long-Distance Lighting Possible

EXPERIMENTS made at the plant of the General Electric Company at East Lynn, Mass., proved, according to officials of the company, the practicability of sending high frequency carrier current, such as is used in radio communication, over electric light feed circuits to light relay lights as far as four miles away from the generating source of the current.

Ordinary 110-volt household lighting current was converted into carrier current by means of a high frequency generator. The output was superimposed upon the 4400-volt house lighting feeder current running from the plant to Nahant, Mass., four miles away.

Two relays of electric lights at the Nahant end of the line were set to different carrier frequencies. When the carrier current frequency coincided with the attunement of one relay of lights they would light up. But when the carrier frequency was attuned to the other relay its lights would glow. The carrier current was transmitted over the lines without interfering with regular lights.

Tests have shown, according to the company, that any number of relays of lights attuned to different carrier current frequencies can be operated individually.



Coil-spring shock absorber of unusual pattern

Another Shock Absorber

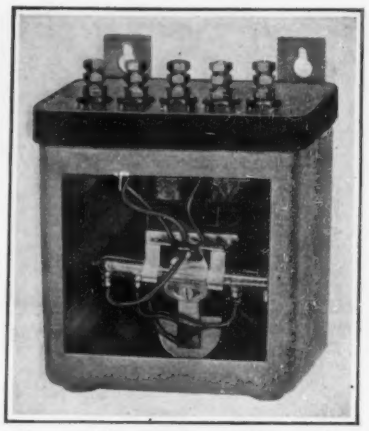
SHOCK absorbers are offered in numerous styles, but few are designed so as to become so integral a part of the suspension system of the car as the one here illustrated. Taking the place as it does of the spring hangers and of all other connection between the spring and the car, it has the direct effect of adding to the length of the spring. Nor is this addition measured by the mere overall dimensions of the device; by virtue of the positive action of the coil spring, the car spring works like one several feet longer than is actually the case. In addition to the coil spring with its cushioning effect, the device includes also a very effective rebound check.

Getting at the Milk Bottle

FILTHY as it was, the old fashioned tin cap for the milk bottle, with its spring clip, was always easy to get off, and it never gave the housewife a milk bath as an incident to its removal. Ever since recognition of its unsanitary character forced it to yield the floor to a card or paper cap that is used once and then discarded, the problem of easy and safe removal of the latter has been plaguing our inventors. The solution which we show at the bottom of the adjoining column appears to have merit. An aluminum cap the size of the bottle-top has two sharp prongs on its under side. It is placed over the bottle-top, the prongs necessarily piercing the paper cap. Then it is tilted off, and necessarily it brings the paper cap with it, while acting as a shield against the geyser of milk which sometimes comes away with the paper.

The Crossing Signal That Cannot Fail

REQUIREMENTS for an electric signal protecting a railway grade crossing are severe. It must be capable of alternately opening and closing two electrical circuits many millions of times, without a change in the contact adjustments and without causing rapid deterioration of the contacts. The most recent attempt to meet this demand uses a totally different principle from its predecessors; instead of an exposed contact, these members are enclosed in a glass tube partly filled with mercury and inert gases.

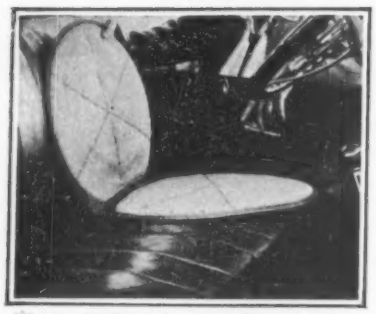


The working parts of the grade-crossing signal that can fail only on the side of safety

This apparatus consists primarily of an armature, oscillating freely between the poles of an electromagnet. To this is fastened a pendulum, which is oscillated in one direction by the electric current, whereupon the current is automatically turned off and the pendulum returns to its original position gravitationally. This cycle is repeated automatically from 30 to 60 times per minute. On this pendulum is mounted the contact tube mentioned above.

Without going into too great detail, it may be said that the contact is made in the mercury when the pendulum is in either extreme position, and broken while it is swinging from the one to the other. The device controls two (or more) red lamps, in such a way that first one then the other lamp is lighted. These lamps are in such positions along a circular arc at the crossing that their successive flashing gives the effect of a single red lamp, swinging back and forth. And the device meets the requirement that if it fails, it must fail on the side of safety; for if the pendulum ceases to oscillate, it must return to the vertical

The splashless milk-bottle opener



The coiled spring in this driving cushion gives resiliency and ventilation

position under the pull of gravity. Then one of the contacts remains permanently closed, and one or more of the red lamps burns continuously.

It will be understood that this signal works only when a train is approaching, the track relay supplying the impulse that sends current to the magnet and to the lamps.

A Crude-Oil Motor without a Carburetor

ONE of our German correspondents sends a description of the motor-cycle outfit illustrated herewith, jumping right into the heart of his subject with the confident pronouncement that "Herr Joseph Loewy has after 15 years' work solved the problem of a crude-oil engine for the motor cycle"; and lending a human touch by informing us that, when the inventor first led his production forth in public, "the crowd was extraordinarily large, in spite of the very cold weather." When the contributor gets down to actual description of the apparatus, we learn that it carries no separate carburetor, but that the mixing of the gas takes place in the cylinder jacket, where we are accustomed to look for the cooling water. Only the upper part of the cylinder is ribbed (apparently for air-cooling), the lower half being surrounded and cooled by the inflowing fuel. By this means the heavy crude oil, ordinarily difficult to thin or to ignite, is so strongly heated that when sprayed through a nozzle it enters the cylinder without any eddying. The motor works on a two-stroke cycle, and develops about one and one-half horsepower. It is started on benzol, and run so for the first two minutes until it gets warmed up. In this connection great importance is attached to a two-duty adjustable nozzle of extreme simplicity, which enables the switch of fuel to be made with no trouble at all. The account closes with a personal touch; Herr Loewy is a "self-made man," this English phrase apparently having been adopted by the Germans. Also, he is apparently not looking for capital to develop the machine, since our correspondent's final sentence pictures the inventor as "unable to save himself" from the importunate captalists who are anxious to share in his prospective profits.

The grease goes into the channels of this waffled frying pan, rather than into the food

Motor Cushion a Coiled Spring

THIS motor cushion for the convenience of motor car drivers is made of an 80-foot coiled spring wound spirally. It gives a good cushioning effect and at the same time maintains an air space to permit heat from the body to escape. The coil is closely covered with a woven textile allowing the circulation of air beneath and behind the back of the driver. It is said to be an unusually cool cushion.

Transformer Oils

THESE oils tend to form sludges, either slowly or quickly, according to the nature of the oil. L. H. Hill describes (*Electrical World*, New York) several tests that may be applied to the oil to determine its tar-forming properties, and gives references to original papers, where the description is more complete. It is certain that the sludge-formation is a form of oxidation. One company has therefore introduced a type of transformer in which the oil is covered with a layer of inert gas, usually nitrogen. A cyclical process, dependent on temperature and pressure, takes place, by which the nitrogen is driven out or sucked into the transformer. Any incoming air passes through an automatic valve, and is then deprived of oxygen and moisture; it therefore becomes dry nitrogen. Thus the oil, being in contact with nitrogen, does not oxidize; the layer of nitrogen also minimizes any explosive phenomena.

Recently exhibited German motor-cycle engine, running on crude oil and dispensing with a carburetor

The Greaseless Frying Pan

FRYING is an operation that requires grease; but the victim of the frying pan knows all too well that he gets too much of this grease in the finished food. How can bacon, pork chops, sausage, lamb chops, eggs, etc., be fried in grease and brought to the table free from grease? The inventor of the waffled frying-pan herewith illustrated has sought to answer this question; and he says he has used the pan in his own household for a year with very good results. The fat expelled by the frying delicacy flows into the channels and stays there, where the food gets all the benefit of its presence without becoming steeped in it. Mr. M. C. Hughes of Allston, Mass., is the inventor.

The Foot-Lock Vise

EVERY vise user has experienced difficulty in holding the work. If it is possible to screw the jaws down hard on the piece in the first place, after working with it for a while it will be found to be loose again. A very efficient vise lock is illustrated, which works with the use of the operator's foot. It is not an attachment for any vise, but must be actually built in. A kick upon the pedal locks the work behind a pressure of several hundred pounds, and a kick releases it with certainty and despatch. The long lever attached to the pedal is the secret; the compounded purchase which this gives enables the jaws to be jammed tight against the work, no matter what the shape of the latter. The screw is used, as in the standard vise, to bring the jaws into approximate engagement with the work after which the foot-lock is called in to clinch the matter.

Fire Tests of Roofing Materials

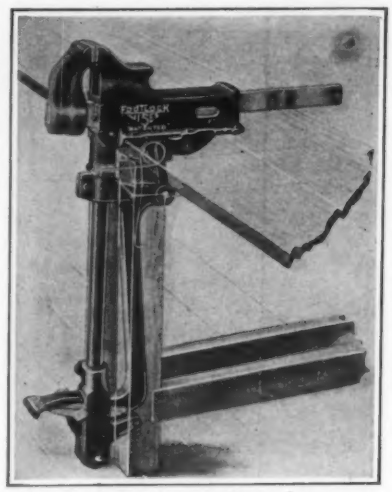
THE Bureau of Standards has prepared a program of tests, equipment is being procured, and test specimens constructed for conducting a series of fire tests of roofing materials with particular reference to the relative merits of wood shingles and prepared roofing.

A conference has been held with representatives of the wood shingle manufacturers, the prepared roofing manufacturers and the fire underwriters, at which agreement was reached on the methods of testing and on an outline of the program of tests.

Diffusion of Nitrogen Through Various Liquids

ONE of the difficulties which the Bureau of Standards has encountered in liquefaction of hydrogen is the securing of hydrogen of sufficient purity. If other gases are present, they become frozen at a temperature higher than that at which hydrogen liquefies. This clogs up the apparatus and stops the process. The storing of hydrogen in any kind of a gas holder is, therefore, a matter of some difficulty because gases are very apt to diffuse through the liquid seal used in the holder and become mixed with the hydrogen.

Experiments were made during the past month on the relative rates of diffusion of nitrogen through glycerine, machine oil and water. It was found that the rate of diffusion through glycerine is very much lower than through water or machine oil. This was to be expected because of the extremely low solubilities of nitrogen and other gases in glycerine. The Bureau now proposes to employ glycerine as a seal for the gas holder used for the temporary storage of pure hydrogen.



The vice that uses foot-power and compound leverage to jam its jaws tightly upon the work

Colorless Waterproofing Materials for Stone

INVESTIGATIONS are now under way at the Bureau of Standards covering the action of frost on building stone and on the value of colorless waterproofing materials with which to protect the surface of stone structures. During the last month the series of exposure tests on colorless waterproofing materials, having for its object the determination of the relative durability of these treatments under weather conditions, has been supplemented by a series of tests to determine the efficiency of the different waterproofing materials in preventing decay of the stone.

Crystallization tests are being made on waterproofed specimens to secure a comparison between treated and untreated specimens. Waterproofed specimens have also been exposed to the weather and will be tested after a considerable period of exposure.

Painting with a Wheelbarrow

CALIFORNIA'S highway commission is now painting a white line down the center of the highway south of San Francisco as a safety precaution to motorists. A very simple and efficient device is used for this purpose. It consists of a paint receptacle carried on a three wheel hand truck, with a hose leading from the receptacle to a paint brush attached to the front of the device just back of the front wheel. This brush applies the paint to the surface of the highway, and a second brush attached a few inches back of the front brush spreads the paint to the proper width. A red line is chalked on the pavement ahead of the paint spreader to guide the operator of the device.

Three-wheeled hand-truck used in painting the traffic line down the center of California roads

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Long-Distance Truck with Bunks

LONG-DISTANCE trucking is always more or less complicated by the necessity for eating and sleeping on the part of the crew. In the endeavor to meet this, one manufacturer has put out the truck illustrated, with two bunks in the front seat. It is not the idea that one driver shall occupy the lower bunk while the other drives from the upper one—this is obviously prevented by the height of the latter. But this arrangement makes it possible for the two-man crew to live entirely in the truck until they reach their destination, and thus to eliminate much of the delay incidental to the nightly stop. Attention is also called to the comfortable inclosed cab which permits all-weather driving.

Rolling Palace Has the Comforts of Home

IF you have a hobby for highly personalized transportation and can write a check running well into five figures you can now gratify every desire for traveling luxury, distinction and novelty. Thanks to the utility value of the modern motor bus, an outlet has been given to the passion for a house on wheels or "sleeping couch" combining every modern convenience with the composite comforts of home, hotel and Pullman. Such is the motor palace recently acquired by W. K. Kellogg, breakfast food magnate and world-traveler. Fond of travel, Mr. Kellogg has toured India, Japan and China and through virtually all European countries. He has made several trips to South America, has been in Alaska twice, in Hawaii and Egypt and now with his club car creation plans on renewing his acquaintance with America's wonders in a more leisurely and intimate way.

With the automotive home there is no further need to "check your baggage and come back later" for a room and bath. Now you just drive and drive and stop where you please. In the wildest wilderness if you like, without the slightest inconvenience — comfortable

By living in this truck, the driver and his helper cover long distances with a minimum of delay

sleeping berths, shower baths, ample cooking facilities, cracked ice made as you ride, market news and entertainment by radio. The club car has all these conveniences and more. Innocent looking panels of mahogany here and there conceal scores of unlooked-for appointments.

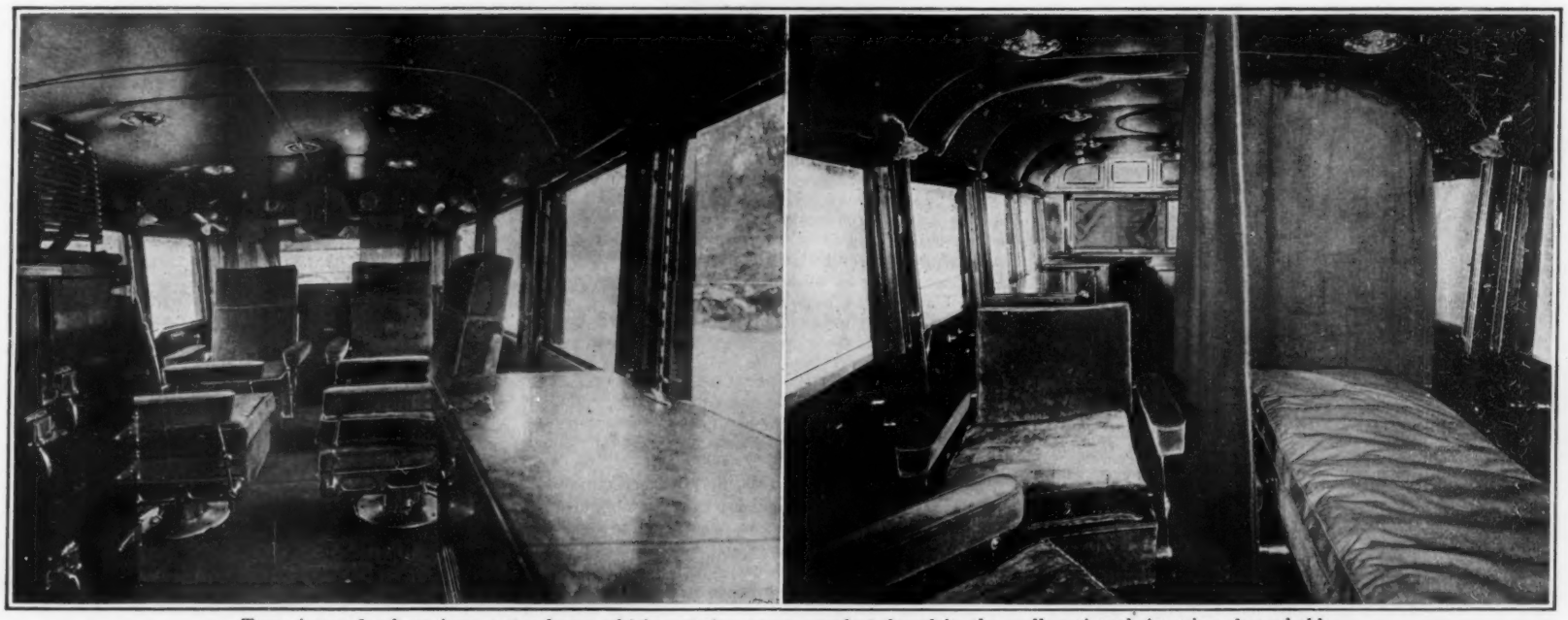
The motor palace is finished in mahogany and the finest of leathers throughout. Entrance and exit may be made through five doors, three on the right side and two on the left. The driver's compartment is separated by a sliding glass partition. The forward part of the car is equipped with four revolving chairs with adjustable backs, head rests and arms which can be quickly converted into full-sized berths for two. The chairs are upholstered in taupe mohair plush with nickel fittings. Heavy adjustable curtains separate the sleeping quarters from the rear compartment as well as the berths. The forward section may readily be transformed into a cozy dining room by the introduction of a folding table which, when not in use, is concealed in a panel at the side of the car. Ample light is provided by dome lamps and separate reading lamps at each chair. A dictograph permits communication with the driver without opening windows. The coach is designed for use in winter as well as summer and passengers need not be concerned by weather conditions. Rotating fans keep the car cool in warm weather while heaters set flush with the floor and connected to the exhaust pipe of the engine keep the car warm on the coldest day.

Further inspection of the rolling home discloses wardrobe and linen closets, oil and electric stoves, sink, faucets for hot and cold water, an ice making plant, iceless refrigerator, a china closet, a nickel hand basin, enclosed chemical toilet, French mirrors and dust-proof screens of fine nickel mesh. Several electrical connections are conveniently located for curling irons, etc. All kitchen utilities and other appointments are concealed when not in use by mahogany cabinets and closets so that the general effect is of pleasing cabinet work and upholstery.

The water supply system for the entire coach is provided by a 40-gallon tank, pressure being maintained at all times by means of a pump driven by a power take-off on the transmission. An electric power plant in the rear section furnishes current for the lamps, stoves and fans. Installed outside of the car is an iron folding frame which can be used to carry light baggage and when extended forms a large bed frame, which with mattress and rain cover offers additional sleeping accommodation. It is possible a few conveniences a completely appointed home should have, have not been enumerated. If so the mansion of ever-changing location has them.

Motors Are Helping the Rural Schools

EIGHTEEN THOUSAND rural schools are furnishing transportation for pupils to and from their homes. Through the motor bus the consolidated rural school is made possible and the number of consolidations is going forward at the rate of 1,000 per year. There are still 180,000 one-room schools which should be consolidated. Since a consolidated school combines several adjacent school districts into one school it means a larger and better equipped school-house, since in the one-room rural school one teacher teaches all grades from the kindergarten to the eighth grade, while in the consolidated school each teacher instructs but two or three grades. This means fewer and more highly qualified teachers and better teaching.



Two views of a luxurious motor home which contains every comfort found in the well-equipped American household

The Heavens in November, 1923

Figures Recently Arrived at Regarding the Great Nebulae

By Professor Henry Norris Russell, Ph. D.

THERE is no chapter of present-day astronomy in which more rapid or remarkable progress is being made than in the study of the nebulæ. A few years ago we knew little about them, except that they were hazy masses of light, far away among the stars, and that the luminous material was gaseous in some cases, and not so in others. Now we think of them as grouped in three definite, though not quite mutually exclusive, classes.

First in order we may mention the vast dark nebulæ, which we detect only because they hide the parts of the Milky Way that lie behind them. We owe our knowledge of these mainly to the lamented Barnard, who, single-handed and at first amid general incredulity, maintained and proved their existence. Some of them are so enormous that they appear as dark patches in the Galaxy, easily visible to the naked eye; others are small and sharply outlined. It is fairly certain that they are actual clouds of matter, and that the fine dust in them produces most of the opacity by which we detect their presence. The nearer ones are at moderate distances—a few hundred light-years; yet even so, they must be dozens of light-years long. These great clouds seem almost like residual fragments of the primeval chaos. There is no reason why we need suppose that they have ever been other than they are.

Next come the luminous nebulæ in the galactic region, including both the diffused and chaotic masses like the Great Nebula in Orion, and the rounded forms called "planetary nebulæ." The beautiful work of Hubble has shown that these nebulæ are always associated with stars, and doubtless derive their light from the stars. In some cases the luminous region is clearly only that part of a greater dark nebula which lies near the star, and reflects its light. In others the luminous material consists of gas, which is set shining by the radiation of the star. Just how this happens we do not yet understand, but it is very significant that the stars associated with gaseous nebulæ are always of the very hottest types—most of all, those which form the nuclei of the planetary nebulæ.

The Spiral Nebulæ

But the most remarkable problem of all is set before us by those nebulæ which lie far outside the Milky Way, and form by far the majority. Hardly any of these show a gaseous spectrum, and very few are chaotic in form. Thousands of them are round or oval, brightening up gradually toward the middle. A smaller, though still great, number show spiral arms extending outwards from a central mass—evidently in one plane, for we have many cases in which they are seen edgewise. All stages of transition appear to exist, from a round structureless mass, through more and more oval forms, to cases in which the spiral arms seem just to have budded out, those in which they are well developed, and others in which little of the central mass is left, while the arms have broken up into innumerable spots of light.

Does this obvious sequence give us a clue to the evolution of these strange objects, or are we merely reading into nature the phantasies of our own imaginations, so far-reaching a question cannot yet be answered fully; but there are many reasons to believe that the sequence has a meaning.

In the first place, these nebulæ are in rotation. For the brighter and inner portions, we know this with certainty from the spectroscopic work of several observers, following the brilliant initial work of Slipher. The motion is in the direction which would carry particles at the rim of the nucleus outward into the spiral arms, and its rate may rise to a hundred miles per second, or even more.

Farther out, where the nebula becomes so faint that its spectrum cannot be photographed with any reasonable exposure, it is fortunately still possible to find the motions of the individual nebulous condensations, by comparing photographs taken at intervals of ten or a dozen years. Van Maanen, at Mount Wilson, has been the protagonist in this difficult field. Seven different spirals, which he has measured, all show motion of the nebular points around the nucleus and, though to a less degree, outward, so that they appear to be streaming away from it along the arms. The motions look slow (a few seconds of arc, at most, per century), but correspond to a complete rotation in from 50,000 to 200,000 years.

This is a surprisingly short period, for the nebulæ are presumably very old, and yet the observed motions would carry their outer portions clear away, into the regions where we now see nothing, in a single million of years. Evidently stuff is coming out of the nucleus and escaping into space—shining at first, then becoming dark. When one of these giant spirals is turned edgewise toward us, this outer region can be seen as a dark, opaque band, crossing the brighter portions.

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

Distances and Velocities

In the last nebula which he has studied—known as Messier 33, from its number in the catalog of nebulæ prepared by that astronomer a century ago—van Maanen has measured four hundred of the almost countless specks of light in its outer portions. One of these showed a relatively rapid motion, and must be a faint star, far nearer us than the nebula; all the others fell in line with the majestic circulation, like a vast whirlpool, spreading outwards. The labor of measuring, with all possible precision, so many objects—not to mention the faint stars used as points of reference—must have been enormous. In fact, the writer may be pardoned in quoting Dr. van Maanen's remark, after talking of the work: "Some time, after forty years or so, somebody ought to get new photographs, and measure a thousand points on this nebula. Before that time I hope to die!"

But the results richly justify the labor. Not only do they give the most complete knowledge of nebular motions which we have yet attained, but they make possible, for the first time, a direct estimate of the distance of the object. One condensation, in the outer part of the nebula, is bright enough to permit a spectroscopic determination of its radial velocity; and it shows a great difference from the velocity of the central mass. If we can safely pass from this motion in the line of sight to motion in the plane of the nebula itself, we may by comparison with the photographs work out the distance. To do this, we need only know at what angle the plane of the spiral arms is inclined to our line of sight. This is rather hard to find, but as the shorter diameter of the nebula appears to be about 80 per cent of the longer, the inclination may be estimated as from 35 degrees to 40 degrees. The parallax then comes out 0.0005 second, the distance about 6,000 light-years, and the rate of motion in the outer mass about 150 miles per second. The nebula is about half a degree in diameter, which, at this distance, corresponds to some 60 light-years.

This appears to be the most trustworthy estimate of the distance and size of a spiral nebula which has yet been made. Other methods, less direct but applicable to more nebulæ, indicate distances of the same order of magnitude. We may well, for the present, think of the larger spiral nebulæ as lying at distances of several thousand light-years, and as being themselves a few thousand light-years in diameter. This is certainly big, but small indeed in comparison with the size of the Milky Way, which is measured in hundreds of thousands of light-years.

It would be tempting to go on to estimate the mass of Messier 33, and if the motion of the outer parts was orbital it would be easy. The period of rotation, at 10 minutes of arc from the nucleus, comes out from van Maanen's figures at 170,000 years. The actual distance from the nucleus should be about 1,200,000 times that between the earth and the sun. To keep a planet moving with this period at this distance, the mass of the nucleus would have to be 60,000,000 times that of the sun!

But fortunately, the motions of the various nebular particles do not follow the ordinary law of orbital motion under gravitation. The orbital velocity, instead of growing smaller at greater distances from the center, gradually increases, while the outward motion diminishes. This is extremely puzzling. The drop in the outward motion might be explained by the attraction of the nucleus; but the increase of the lateral motion, at right angles to the radius, demands the action of a force which is neither attraction nor repulsion, but acts sideways. No one has any idea what such a force can be, and it may take much work before the right clue is found. The most obvious suggestion is that the luminous points in the outer part of the nebula are not flying freely in empty space, but are immersed in a great moving sheet of dark matter, which drags them along with it; but this, too, presents great difficulties.

We need not mourn, however, because there are still worlds to conquer. It is ground enough for satisfaction that we have so good an idea of the size and distance of this wonderful object. Even our rough estimate of its mass may be of some value. If there were not enough stuff in the nebula to make millions of suns, it is hard to see why the fast-growing condensations do not fly off in straight lines, instead of in their obviously curved paths.

The Heavens

By this season the winter constellations are returning to our view. Orion is high in the southeast with Taurus above and Sirius blazing below. Gemini and Canis Minor are to the left, with Auriga higher and further on. Perseus is high in the northeast and Cassiopeia and Cepheus in the north, while the Dragon and the Bears are below the pole. Cygnus is well down in the northwest, with Lyra and Aquila setting below. The southwestern sky is dull, the great square of Pegasus being the only prominent configuration within it.

The Planets

Mercury is in conjunction with the sun on the 10th,

(*Continued on page 376*)

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—L. JACOBY, Paris, Ky. This invention relates to controlling means for airplanes and has for its general object to provide means which may be embodied in the structure of an airplane and which will permit an exceedingly flexible control. It is also an object to provide means whereby the normal descent or ascent of the plane may be accelerated, and means whereby to facilitate the control of the airplane when in flight.

AERIAL PROPELLING MACHINE.—S. V. CORTES, c/o Chilean Naval Com., 56 Victoria St., Westminster, London, S. W. 1, England. The main object of this invention is to provide a permeable casing with deflecting vanes for enclosing a rotary propelling mechanism, and which can be adjusted by means of suitable mechanism, in order to obtain an efficient utilization of the forces developed by the rotation of the propelling mechanism in the required direction.

Pertaining to Apparel

GARMENT POCKET.—G. W. WALKER, 2207 Seminary Ave., Oakland, Calif. The invention relates more particularly to a pocket which is best suited according to its peculiarities to workmen's garments, such for instance, as overalls, carpenters' aprons, coats and the like. Among the objects is to produce a pocket which will conveniently accommodate a quantity of nails or other articles, and remove the likelihood of the dropping out regardless of any tilted position.

GARMENT.—I. ROGGEN, 5 Beekman St., New York, N. Y. One of the primary objects of the invention is to provide a placket especially adapted for shirt sleeves. A further object is to provide a placket in which the material employed in the manufacture thereof may be reduced, thus making it possible to use scraps rather than good material and thereby reducing to a minimum the waste in good material.

GARMENT SUPPORTER.—J. S. WALLINGFORD, 305 1st Nat'l Bank Bldg., Paris, Ky. The invention relates to a clasp element for use in connection with hose supporters which reduces to a minimum the tearing or destruction of the garment by distributing the supporting strain over a wider area of the garment. Further the invention aims to produce a clasp which, when properly associated, insures the retention of the garment against accidental displacement, while at the same time permitting of ready release and application.

Electrical Devices

TERMINAL FOR DRY BATTERIES.—H. M. KORETZKY, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y. The invention aims to present a type of battery which may be so constructed as to preclude the danger of any loss of the terminal clamps, the terminal further embodying the feature of adaptability to the carbon electrode so that no danger of a loosening of the former from the latter, and a resulting bad contact is to be feared

2.—WHAT IS A PATENT?

A PATENT is a purely statutory creation, and there is no common law right of property in an invention. In its inception the patent right was a monopoly granted by the Crown. During the reign of James I the English Parliament established the beginnings of patent rights as we know them in present times, by taking from the Crown the right to exercise this power of granting patents, except in the case of inventions. The patent today is property; it is a franchise; it is a contract with the Government, by virtue of which the inventor, in consideration of his giving the public knowledge of his discovery, receives in return a monopoly thereof for a limited period, at the expiration of which the discovery becomes public property, and, in so far as that patent is concerned, may be freely made, used, sold or practiced by all. As patent rights are property, the owner thereof is entitled to the same protection therein, both legally and equitably, as in the case of any other property, and he may likewise by assignment, divest himself of his property as he may see fit. A patent, contrary to a general acceptance of the idea, does not grant the right to make or use the subject-matter thereof; it merely grants the right to exclude others from so doing, if the owner of the patent so desires. But the mere grant of a patent, even an entirely valid patent, does not preclude that the subject thereof infringes an equally valid but earlier and broader patent. Thus, the patentee may find himself the owner of a patent, and yet he may not be able to use the subject-matter of that patent without infringing the corresponding patent rights of another patentee. On the other hand, no one may, without the consent of the later patentee, make use of the patented subject-matter of that later patent.

TELEPHONE SUPPORT.—J. J. MOSS, 3406 Lexington St., Chicago, Ill. An object of the invention is to provide a telephone support which may be readily secured to a wall or the like, and which has means for readily and instantly adjusting the telephone to the desired height. A further object is to provide a device which has means for supporting the receiver when the latter is not disposed on the telephone hook.

CHANGEABLE COLOR SPOTLIGHT.—J. M. DOLLISON and C. E. SMITH, Address C. E. Smith, 39 Ruggery Bldg., Columbus, Ohio. An object of the invention is to provide an apparatus for projecting rays from an electric bulb through a colored screen in order to provide illumination for exhibiting window displays. A further object is to provide a rotating color disk having translucent portions of different colors for creating the effect of continuous blending of color.

ELECTROLYZING APPARATUS FOR THE MANUFACTURE OF OXYGEN AND HYDROGEN.—G. F. JAUBERT, 155 Boulevard Malesherbes, Paris, France. The invention relates to apparatus to be used for the manufacture of oxygen and hydrogen, it comprises a tank containing an electrolyte, nickel electrodes having tubular stems of the same material, a frame supported in the tank and supporting the electrodes and foraminous diaphragms of fine mesh and mounted in the frame and separating the electrodes.

Of Interest to Farmers

ATTACHMENT FOR TRACTORS.—H. M. GREASLEY, Corry, Pa. The invention particularly relates to an attachment adapted to operate for preventing a wheeled tractor from turning backwards, upon the rear drive wheels being held in a roadway or field, against rotation. An object is to utilize the movement of the tractor body or frame, when said tractor is turning backwards, for operating mechanism adapted to stop the power to the driving shaft; the mechanism is simple and adapted to be applied to any type of wheeled tractor.

MANURE LOADER.—F. E. NULL, 1109 W. Springfield St., Urbana, Ill. The invention has for its object to provide a machine which is effective to completely gather or pick up the material from the ground, elevate it without loss or scattering, and transfer it to a lateral conveyor movable in either direction and controlled by an operator. The device is in general simple and durable, comparatively easy to operate, and inexpensive to manufacture.

TRACTOR HITCH.—M. M. KNOWLES and J. N. BATES, Fort Branch, Ind. The general object of this invention is to provide a brace that will cause a side draft hitch to function as if the hitch were central with the line of draft and which will be free to automatically adjust itself to a complete turning movement of the tractor and yet be adapted to be made rigid as is desirable when operating over rough ground.

FENCEPOST ATTACHMENT.—P. T. BAILEY, Box 272, R. R. 2, Newport, R. I. Among the objects of the invention is to provide an attachment at the top of the fencepost for retaining a pipe or bar in position, and which in addition presents means for carrying fencing wire and thereby permits the use of a comparatively short post and at the same time presents an ornamental appearance.

GRAIN SHOCKER FOR HARVESTER BINDERS.—J. E. DERY, Edgeley, N. D. The purpose of the invention is the provision of an attachment to be applied to various makes of harvester binders whereby the bundles of grain delivered from the binder are formed into shocks and deposited upon the ground in an upright position. A further object is the construction of a shocker that may be readily adapted to harvester binders without requiring changes.

Of General Interest

LIFE-BOAT APPARATUS.—F. A. GRAHAM, Harbor Springs, Mich. The invention has reference more particularly to an apparatus which is manually operated and does not require fuel, and which is adapted to actuate the propeller by compressed air, the heat from compressing said air being utilized in distilling salt water for drinking purposes. An object is to provide an apparatus which may be operated by the occupants of the boat for providing distilled water, and compressed air as power to operate the propeller.

COUPLING.—J. ZAJIC, 520 E. 81st St., New York, N. Y. The invention relates to a coupling particularly intended for connecting the ends of a cord or rope, or for attaching a snell to a fish line. The general object is to provide a coupling of very simple form with a view to promoting convenience in applying the coupling to effect a secure connection between the coupled elements. (See Fig. 1.)

WINDOW DOG KENNEL.—C. CHAPLIN, 258 Madison Ave., New York, N. Y. An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house or other dwelling, and connected to the window frame in such manner as to be properly supported and protected from rain, the arrangement being such that access may be secured thereto at any time from the interior of the building. (See Fig. 2.)

COMBINED RULER AND BLOTTER.—A. AZCONA, Magdalena, Mexico. One of the principal objects is to provide a device which facilitates the ruling of lines with pen and ink without soiling or blotting the paper, and the blotting of the lines or writing by rolling the blotter over the same, thus preventing smearing and further eliminating loss of time in picking up a separate blotter. The device consists of a plurality of sections, the outermost being adapted to be removed and discarded when unfit for use. (See Fig. 3.)

COMBINED PAIL AND STAND.—A. G. HARRINGTON, 415 Ann St., Birmingham, Mich. In paper hanging or many other forms of labor where a pail is used it is necessary for the worker to frequently stoop for dipping the brush or the like. The object of the invention is to provide a combined pail and stand whereby the pail may be quickly elevated and so held wherever the user may wish, and thus eliminate the tiresome stooping. (See Fig. 4.)

FOOT REST.—F. P. LITZ, address D. F. Smith, attorney, Corry, Pa. The object of the invention is to provide a foot rest for use with bootblack stands or the like, which is adjustable and removable whereby when the foot rest is not in use it may be removed or adjusted so that it will not afford an obstruction liable to catch and tear the clothes of a person using the rest, or impede the movement of a person in stepping upon or leaving the stand.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. The inventor

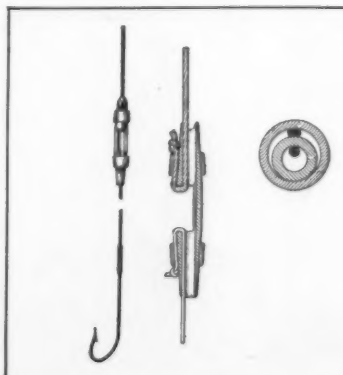


Fig. 1. J. Zajic's ingenious device which saves time for fishermen

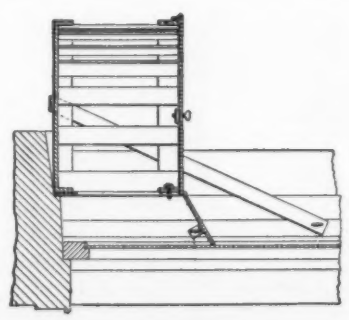


Fig. 2. This window-sill dog kennel for apartment dwellers is the solution made by C. Chaplin

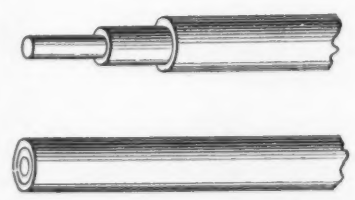


Fig. 3. The invention of A. Azcona facilitates the ruling of inked lines

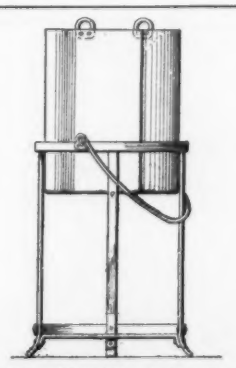


Fig. 4. This adjustable paint pail stand to obviate stooping is the invention of G. Harrington

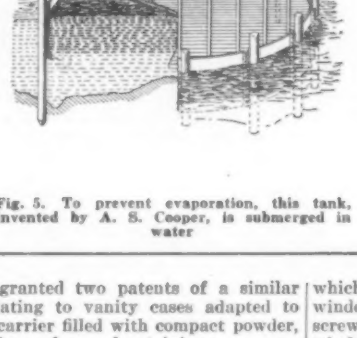


Fig. 5. To prevent evaporation, this tank, invented by A. S. Cooper, is submerged in water

Fig. 6. Motorists will appreciate this simple portable mudhole bridge, the idea of R. D. Gallager

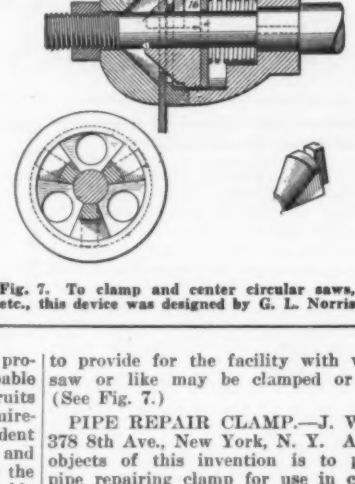


Fig. 7. To clamp and center circular saws, etc., this device was designed by G. L. Norris

has been granted two patents of a similar nature relating to vanity cases adapted to contain a carrier filled with compact powder, and provides a form of retaining means on opposite sides of the central partition of the carrier so constructed that it will in no way interfere with the powder packing or pressing operation. The retainers may be removed from the case for the purpose of renewing the cosmetics when the same become exhausted. A further object is to provide a device which will be simple, neat and attractive in appearance.

SPIRAL ROPE AND CABLE GRIP.—G. J. ZINK, 2313 Folsome St., San Francisco, Calif. The invention relates to means for securing a cable or rope around an object, as, for instance, a log of wood to be moved, or on the front axle of an automobile to be towed. A particular object is to provide means for temporarily securing a cable which can be fastened and unfastened without any effort and still positively secure the cable to the object so firmly that it cannot lose its grip, no matter how much towing power is applied.

GATE VALVE.—J. E. DEMPSEY, c/o Acme Cement & Plaster Co., Olive and 9th Sts., Acme, Okla. Among the objects of the invention is to provide a gate valve especially adapted for application to grain bins and the kettles of plaster mills, although the valve is capable of a variety of applications and may be applied to a cylindrical container and the attaching face of the casing may be concaved and the discharge spout either straight or inclined.

CLASP.—L. JABNER, P. O. Box 1665, Station C, Los Angeles, Calif. Broadly speaking, this invention contemplates a clasp for jewelry, including a pair of members, one of which is adapted to receive the other and within which former member means is arranged for coacting engagement with the other member to lock and retain the members together against separation, with exteriorly exposed means for releasing the locking means.

CLOSURE FOR CONTAINERS.—D. BLOOM, 1538 Edith St., Berkeley, Calif. The primary object of the invention is to provide a closure which will positively seal jelly and preserve glasses and tumblers, and which may be produced at a modest cost. A further object of the invention resides in the simple manner in which it is applied, which enables the closure to be used by housewives as well as packers operating on a large scale.

SCREENED DRAIN.—T. C. KUNKEL, Madrid, Neb. An object of this invention is to provide a screened drain which is adapted to be used on a window or door screen and which may be easily attached to the ordinary window screen without the use of nails or screws. A further object is to prevent the window screen and window sill from decaying by permitting the water to drain, at the same time preventing insects or the like from entering.

FIRE EXTINGUISHER.—P. BRAUDE, 229 Madison Ave., New York, N. Y. The principal object of the invention is to provide a simple and inexpensive package which is indestructible by fire whereby the same could be used as a bomb to be thrown directly into the flames to extinguish the same. A further aim is to provide a frangible closure readily broken by the finger to permit the emptying of the contents onto the flame.

MATCH CASE.—S. SPRAGUE, Box 481, Times Plaza, New York, N. Y. Among the objects of this invention is to provide a case or container for dispensing the contents thereof and delivering the matches singly, whereby the case may be employed as a holder for the lighted match to preclude the possibility of burning the fingers, means being provided for ejecting the used match; the device may be used in connection with common form, or safety matches.

WINDOW.—S. U. BARR, c/o W. H. Jackson Co., 335 Carroll St., Brooklyn, N. Y. This invention has for its object to provide a window arranged to permit of easily and conveniently moving the sashes up and down and to render the window air and water tight at the time the sashes are in closed and locked position, and without the use of packing strips or the like.

LOCKING DEVICE FOR FRUIT CANS OR THE LIKE.—H. H. ORDUNG, 114 H. St., Laporte, Ind. An object is to provide a locking device which is adapted to closely engage with the walls and top of the can whereby it will not interfere with the packing of the can. A further object is to provide a device which may be readily attached to cans of ordinary construction without altering their construction. The device consists of few parts, and is not likely to get out of order.

FACING FOR CEMENT WALLS.—F. A. NORTHWALL, 4th and Wood Sts., Portland, Oregon. This invention has for its object to provide a facing for walls whereby the exterior of the cement wall of a house or the like may be given a neat and artistic appearance. It is also an important object that the facing may be adapted to be locked in position at the time of building or pouring the cement.

DIVISION PLATE FOR EGG CASES.—J. C. VOORHORST, 436 Star Bldg., Washington, D. C. The invention aims to provide a dense packing division plate capable of safely transporting eggs, bottles, fruits and the like, which will answer all requirements in the nature of conditions precedent to its use in storage, ocean transport and through the mails. A further object is the provision of a plate which will be yieldable to permit of expansion or contraction, and for properly fitting egg-case compartments of non-standard dimensions.

MOUNTING FOR STYLUS LEVERS.—G. W. SLIGHT, P. O. Box 220, Framingham, Mass. The general object is the provision of a simple mounting for stylus levers in sound boxes, provided with a self-compensating means for taking care of the wear in the bearings. These objects are accomplished by the provision of a lever having a trunnion extending at right angles thereto, forming bearings in the casing, one of which is a groove extending at an angle to the axis of the trunnion, and mounting on the casing a spring which tends to draw the trunnion along the groove to compensate for wear.

TANK.—A. S. COOPER, 610 So. Broadway, Los Angeles, Calif. The invention relates to tanks for the storage of oil or other liquids which are lighter than water. An object is to provide a bottomless tank of this character partly submerged in a body of water so that it will be in convenient position for storage of fuel oil, with small loss by evaporation. The device may be easily erected and transported to different localities, the walls being of light construction, either of metal strips that may be rolled horizontally, of wooden slats with metal bands. (See Fig. 5.)

PORTABLE BRIDGE.—R. D. GALLAGER, Bay St. Louis, Miss. Briefly stated, an important object of the invention is to provide a portable bridge, adapted for emergency use, which may be conveniently attached to the upper or lower side of the running board of a vehicle, and readily set up for use when necessary. A further object is to provide collapsible sides which, when swung to an upright position, will brace the tread portion of the bridge. (See Fig. 6.)

Hardware and Tools

CENTERING AND CLAMPING MEANS FOR SAWS AND OTHER ARTICLES.—G. L. NORRIS, 224 W. 2nd St., Wilmington, Del. The invention relates to arbors for saws, emery wheels or the like, and particularly to means for centering the saw on the arbor and clamping the same in position. The general object is to provide a centering and clamping means whereby to promote simplicity of assemblage, secure fastening, and to provide for the facility with which the saw or like may be clamped or released. (See Fig. 7.)

PIPE REPAIR CLAMP.—J. W. BLAIR, 378 8th Ave., New York, N. Y. Among the objects of this invention is to provide a pipe repairing clamp for use in connection with boiler and refrigerating plants where the device is to be applied to one of a nest of closely spaced pipes; by this device it will be possible to associate the body portion of the clamp with one of the nest of pipes irrespective of the proximity of the next adjacent pipe.

BRACKET.—B. V. CZARNECKI, 907 Campbell Ave., Schenectady, N. Y. This invention relates to brackets especially adapted for supporting shade rollers and curtain rods. An important object is to provide a bracket which is neat in appearance, stamped from a single blank of metal and having means whereby the same may be secured to a window frame without employing nails or similar fastenings, which mar the appearance of the frame.

AUTOMATIC LOCK COCK.—J. T. O'GORMAN, 1968 Morris Ave., Bronx, N. Y. The invention particularly relates to a safety device for locking a gas cock or other form of valve adapted to be moved from an open to a closed position or the reverse. The object is to provide a lock which will automatically become locked when moved to a closed position, but will permit the valve to be adjusted and manipulated by the same hand which opens and closes the cock. (See Fig. 8.)

FISHING TOOL.—C. H. BROWN, Breckenridge, Texas. An important object of the invention is to provide a grapple or fishing tool, especially adapted for use in connection with oil and other wells, having means whereby the same may be engaged with the food valve of an oil well for the purpose of removing the valve, the grapple is so constructed that its movement upon being engaged with the valve is limited, whereby the spring arms are enabled to withstand the strain incident to use. (See Fig. 9.)

ADJUSTABLE BRACE.—W. LEMOIGNE, Box 664, Colusa, Calif. This invention relates to braces used for imparting rotary motion to tools, such as drills, screwdrivers and others, the particular object being to provide a brace that may be used in the ordinary way but possesses special features of adaptability and can be used in almost any corner or under any conditions where the ordinary brace would be practically useless. It is a further object to produce the brace without materially increasing the cost of manufacture. (See Fig. 10.)

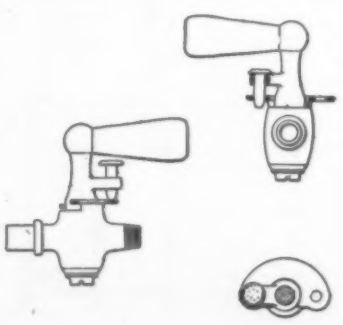


Fig. 8. For locking a gas cock in the desired position this is J. T. O'Gorman's idea

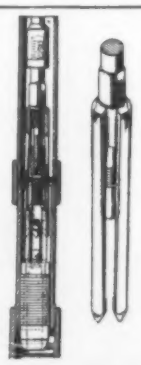


Fig. 9. This fishing tool for oil wells was devised by C. H. Brown

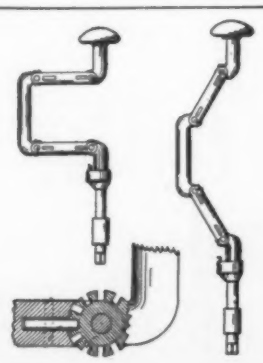


Fig. 10. An adjustable brace for tight corners is the needed invention of W. Lemoigne

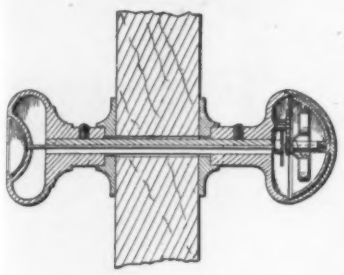


Fig. 11. Here is a simple, practical doorbell and button combined by J. A. Baginley with the knobs

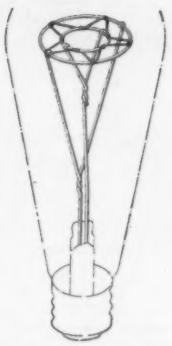


Fig. 12. Breaking of electric light filaments is less annoying, following the invention of this device by A. S. Volpian

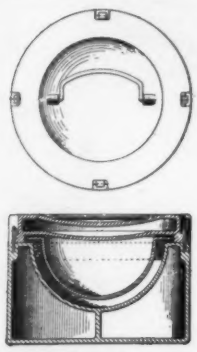


Fig. 13. Conservation of fuel is the idea behind this vacuum-receptacle heater designed by R. W. Owens

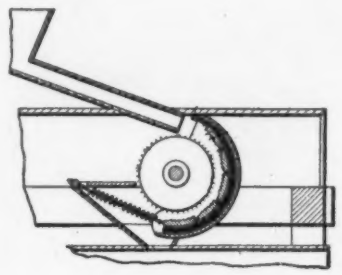


Fig. 14. In this machine H. Warren decorticates nuts

FURNACE GRATE.—H. BENTON, 657 Jefferson Ave., Elizabeth, N. J. The general object of the invention is to provide a construction whereby grids on grate bars present an increased area and the dead or fixed grate surface is practically eliminated, whereby also an increased air circulation is provided at the sides and center of the grate and an increased amplitude of movement in the shaking and dumping of the grate is provided for.

DOORBELL.—J. A. BAGINLEY, 2535 Pacific Ave., Hoquiam, Wash. The object of the invention is to provide means whereby a bell may be carried on the knobs of a door in such a manner that the bell may be easily operated from the exterior door knob. It is also an important object that the bell will in no way lessen the artistic appearance of the door knobs. (See Fig. 11.)

Heating and Lighting

LAMP FILAMENT AND SUPPORT.—A. S. VOLPIAN, 120 W. Washington St., Greenville, S. C. An object of the invention is to provide a filament and separated supporting elements with which the filament has contact at various points so that should the filament break or current be otherwise interrupted at one point the remainder of the filament will be continued in circuit with the supporting elements and illumination maintained. A further object is to provide a support to prevent short-circuiting, as well as provide strength. (See Fig. 12.)

GRATE CONSTRUCTION.—C. A. SHIVELY, 809 North "M" St., Tacoma, Wash. Among the objects of this invention is to provide a grate construction for boiler furnaces and the like, so formed and arranged that the bearing bars may expand or contract longitudinally or transversely or become distorted on account of the heat or weight without injuring the supporting walls of the device or rendering the same unserviceable.

COOKING UTENSIL.—H. J. DANIEL, Sutherlin, Va. The object of this invention is to provide a steamer especially adapted for use in canning or for cooking a number of foods simultaneously. An important object is to provide means whereby the rise of the water level of the outer receptacle due to increase in steam pressure may be utilized to relieve the steam pressure and thereby prevent the water in the outer receptacle from overflowing onto the stove.

OIL BURNING ATTACHMENT.—A. KAISERMAN and A. ZAUGG, 12515 Woodward Ave., Highland Park, Mich. The invention relates to oil-burning means employing steam to atomize the oil or heavy hydrocarbon being burned and more particularly relates to an attachment designed to be employed in connection with the steam boiler of a heating system, a hot-air furnace or the like. The general object is to provide an attachment arranged to promote convenience in installation, operation and repair.

VAPORIZER FOR LIQUID-FUEL BURNERS.—J. E. MALIVERT, 9 Rue du Telegraphe, Paris, France. The object of the invention is to provide a gasifying device for soldering lamps, soldering-irons, chafing-dishes and similar articles in which gasoline is used. The device is adapted to prevent the carbonization of the cotton wick by spacing the same from the burner and thus insuring the proper functioning of the wick at all times.

BOILER AND WATER HEATER.—J. CONFER, 94 Cannon St., New York, N. Y. The invention pertains more particularly to a device for utilizing waste heat in the chimney of a boiler. One of the primary objects is to so construct the device that it may be attached to the chimney of a boiler in such manner as to utilize the waste heat for the purpose of heating water and provide an unobstructed circulation of water at all times.

OIL-BURNING APPARATUS.—W. E. FISHEY, 717 W. Main St., New Iberia, La. The invention relates to oil burners for use in connection with steam boilers, a purpose is to provide an oil burner by means of which the intensity of the flame emanating from the burner is automatically controlled in accordance with the variance in pressure of the steam in the boiler and in such manner that the relative proportions of oil and steam applied to the burner remain constant.

Machines and Mechanical Devices

TAPE FEED FOR MOISTENING MACHINE.—R. M. BROOKS, Root 2, Roseburg, Oregon. This invention relates to a device for handling adhesive tape. A special object is to provide means by which a portion of the tape may be separated from a roll by merely pressing on a foot pedal and in which the separated piece is moistened simultaneously so that it is ready for immediate use.

HOISTING MACHINE.—C. UHL, 301 Chickasaw Ave., Bartlesville, Okla. Among the objects is to provide a machine for hoisting the casing, tubing and rods from wells. The foremost object is to provide a combined hoisting machine and coupling, both being embodied in an automobile truck, and so arranged that when the coupling is joined in one way the truck will be operated as such, and when the coupling is shifted into connection with the hoisting apparatus the machine may be used for that purpose.

CORE AND CHUCK.—P. DE MATTIA and B. DE MATTIA, c/o Munn, Anderson & Munn, 233 Broadway, New York, N. Y. The invention relates to the manufacture of pneumatic tires. An object is to provide a core and chuck mounted upon a revoluble table forming part of a jack, and so connected that they may be quickly removed, and that the connecting device shall form an effective connection not liable to disarrangement while turning the core as the tire is formed thereon.

HOT-SLAG RECEPTACLE.—E. E. JAMES, c/o R. W. Owens, 25 W. 84th St., New York, N. Y. This invention relates to a portable receptacle of the vacuum type for holding a quantity of hot slag, the device being so constructed that the receptacle may be filled at the smelters and transferred to a dwelling or other place where the slag could be used in a so-called fireless cooker, or for other heating purposes. (See Fig. 13.)

METHOD AND APPARATUS FOR DECORTICATING NUTS.—H. WARREN, 108 City National Bank Building, Galveston, Texas. The object of this invention is to provide a device for removing the fibrous husk of nuts by severing the husk structure with a cutting action along lines extending longitudinally of the nut, and simultaneously prying the severed portions radially of the nut and twisting them circumferentially with respect thereto. The nuts are fed to the husker singly, the husks completely removed and disassociated from the nuts. (See Fig. 14.)

TURBINE.—L. DE SANTIS, c/o Russo, 2419 Arthur Ave., Bronx, N. Y. Primarily the invention contemplates a turbine having independably actuated rotor units mounted on a common drive shaft and arranged in a common housing whereby the reverse driving of the drive shaft may be obtained and whereby when one of said units is actuated, the other inactive unit will constitute a balance or flywheel for the other. The turbine is constructed with a primary intake and a plurality of auxiilary intakes, and with manually controlled means for increasing or decreasing the pressure against the rotor. (See Fig. 15.)

PROPELLING ATTACHMENT FOR BOATS.—J. N. COUGHLAN, 209 W. 115th St., New York. This invention has for its object to provide means whereby a person can, with a comparatively slight effort, very readily operate the boat by means of a propeller which is connected with a support readily applied to and removed from the boat structure. The support or frame contains all the necessary elements for propelling and steering the boat without requiring any alteration of the boat structure. (See Fig. 16.)

CLAPPER VALVE.—A. F. THORSTEN, 349 11th St., Brooklyn, N. Y. The invention relates to valves for outboard discharge of waste, and especially to scupper discharge pipes of ships. The aim is to produce a clapper valve which is so constructed that it remains closed at any angle from the horizontal to the vertical, irrespective of the rolling or plunging of a ship, yet requires a minimum amount of water to effect its opening. (See Fig. 17.)

ELEVATOR SYSTEM.—W. GROMER, 36 8th St., Woodside, L. I., N. Y. The principal object of the invention is to provide an elevator system involving the use of a plurality of cages and guides with supporting and controlling means therefor, whereby a cage is not limited to ascend or descend in a single shaft, but may be shifted at different levels from one shaft to another, whereby a greater plurality of cages may be employed than the number of shafts, and a greater number of passengers transported in a given period of time. (See Fig. 18.)

POSITIVE LET-OFF MOTION FOR LOOMS.—J. A. PORTER, Shiley Mills, Macon, Ga. The general object of the invention is to provide a positive let-off for looms by the action of which the warp will be at all times under perfect control. An important object is to provide a positive let-off motion that will be independent of the beam so as not to be subject to the variation due to the varying diameter of the warp beam.

FILM CLEANING APPARATUS.—M. COHEN, c/o I. Pulver, 1015 Longwood Ave., Bronx, N. Y. The invention relates particularly to an apparatus for cleaning moving picture films. The object is to provide an apparatus which will clean both sides of the film without in any way injuring the same, the device gently washing the sensitized side and then polishing the unsensitized side.

APPARATUS FOR MANUFACTURING FLOWERS OF SULFUR.—E. KNAPP, J. K. DICKERSON and F. L. BEGTRUP, c/o G. F. Thompson, Niagara Sprayer Co., Middleport, N. Y. This invention pertains to a condensing chamber into which the vapors of sulfur are led and condensed to finely divided powdered sulfur, which is commonly known as "flowers of sulfur." Among the objects is to so construct the chamber that the liquid sulfur may be collected at a point where it is formed and separated and

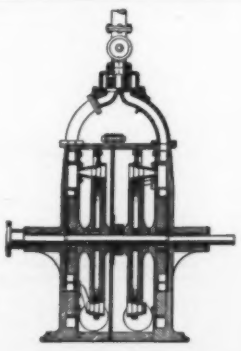


Fig. 15. This improved turbine is the result of efforts by L. De Santis

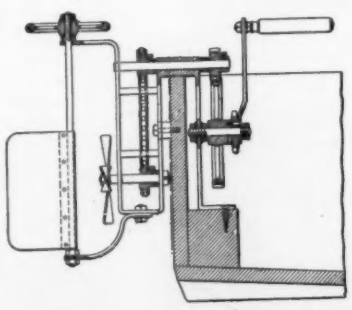


Fig. 16. Here a hand operated crank and propeller replaces the oars in small boats. Invented by J. N. Coughlan

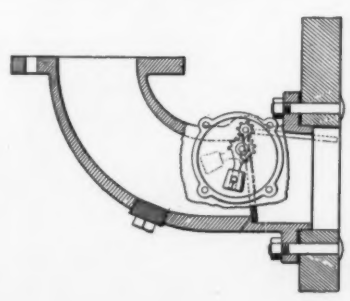


Fig. 17. Shipbuilders will recognize the merit of this automatic scupper valve, devised by A. F. Thorsten

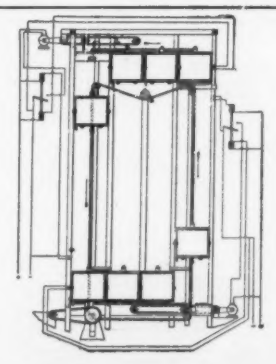


Fig. 18. This flexible system of elevators is the product of W. Gromer

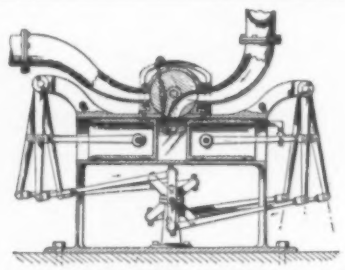


Fig. 19. Acting on the rotary valve and piston principle, this hydraulic motor is the invention of R. Rivera

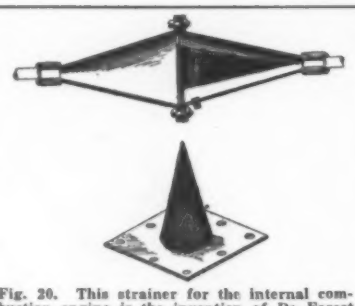


Fig. 20. This strainer for the internal combustion engine is the invention of De Forest Byers

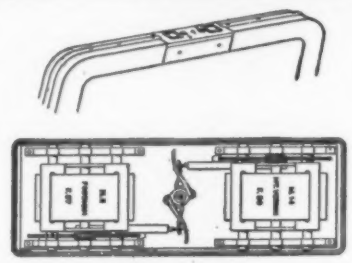


Fig. 21. By using this clever device of N. J. Ryan's railways will prevent free riding of passengers

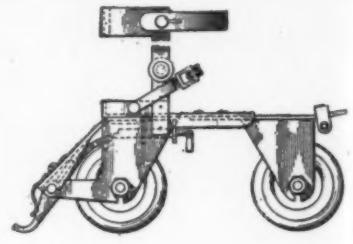


Fig. 22. W. O. Carley's roller skate has a brake and two wheels only

maintained at all times separable from the flowers of sulfur formed within the chamber.

SURFACING MACHINE.—W. H. FRANCIS, Coffeyville, Vitrified Brick & Tile Co., Coffeyville, Kans. The aim of the invention is to provide a device to be used in conjunction with the manufacture of bricks, and for the purpose of making mat-texture facing brick. A further object is to provide a machine by means of which mechanism is provided not alone serving to dig the surface but to also redeposit the dug material upon the face of the member.

PACKING FOR PUMPS.—W. A. O'BANNON, 519 E. 1st St., Tulsa, Okla. Among the objects of the invention is to provide a packing for use in connection with pumps of oil wells of the type in which the cylinder moves with relation to the plunger during the operation of the pump. A further object is to provide a packing adapted to be used between the plunger and traveling barrel and sealing the same in an efficient manner. The packing is simple and may be applied to different types of pumps.

CLEANING APPARATUS. — J. M. STEPP, Williamson, W. Va. The invention relates to a device adapted for use in cleaning such floor coverings as carpets and rugs. An object is to provide a device whereby a cleaning solution or pure water may be applied in the form of a spray to a floor covering and picked up by means of a suction head which also picks up the dirt encountered, and leaves the rug or carpet clean and dry.

HYDRAULIC MOTOR. — R. RIVERA, Sonsonate Salvador, C. A. The object of the invention is to provide for a simple automatic action in hydraulic motors through the use of a readily adjustable, readily controlled valve mechanism, which may be thoroughly and effectively lubricated, and which is capable of ready and convenient repair or substitution of parts at all times. The parts are mostly in full view, therefore, any adjustments or repairs, if necessary, are a simple matter. (See Fig. 19.)

Prime Movers and Their Accessories

STRAINER. — DE FOREST BYERS, Box 185, Clear Lake, Iowa. This invention relates generally to gasoline straining attachments for internal combustion engines of various characters and in various uses, and more particularly to a strainer which may be readily interposed within the gas supply line, for instance, between the supply tank and the carbureter to prevent the passage of sediment along with the fuel into the carbureter. This device when installed needs attention only at long intervals. (See Fig. 20.)

FLEXIBLE COUPLINGS.—E. SCHWARZ, c/o Magneto Attachment Co., 3608 Park Ave., New York, N. Y. The invention pertains more particularly to shaft couplings of the flexible type. The primary object is to provide a coupling for magnetos, generators and other accessories used in connection with internal combustion motor power plants. It is a further object to construct a coupling by means of which the armature shaft of the magneto is adjustable relatively to the driving shaft to permit of a proper timing of the magneto.

Railways and Their Accessories

INDICATOR FOR CAR SEATS.—N. J. RYAN, 51 Main St., Tuckahoe, N. Y. The invention relates to an indicating mechanism to be associated with the back of passenger car seats, more particularly on trains engaged in suburban traffic, with a view to circumvent dishonest passengers who purchase tickets entitling them to travel a comparatively short distance and attempt to ride beyond the station to which the ticket has been purchased. The general object is to provide an indicating means which is both simple and durable. (See Fig. 21.)

CAR DOOR FASTENER. — W. KANE, 141 Margaret St., Sarnia, Ontario, Canada. The invention has for its object to provide a device which is easily operable to secure or release the car door in either fully closed or partly open position and which is adapted to secure the door in closed position or in partly closed position as desired in such manner as to admit of ventilation of the car. The device is of simple and durable construction.

BRAKE-ROD ATTACHMENT.—J. W. CONNELL and J. ARMSTRONG, Centralia, Wash. An object of the invention is to provide means whereby the action of a brake rod is cushioned so as to increase the braking power and prevent the brake shoes from being too suddenly applied in case of an emergency application of the brakes. A further object is to provide a rod attachment which may be readily applied to engines, passenger coaches, freight cars or street cars without substantial alteration to the original construction.

AUTOMATIC TRAIN STOP.—E. DE LEON, Remedios, Cuba. The general object of the invention is to provide an automatic train stop controlled by truck movement, a more specific object being to provide a train stop that will be sensitively responsive to the dropping of the front wheels of the truck to dispose the truck in an oblique position in the absence of a rail in its proper place, the movement of the truck from a normal position serving to actuate valve opening means for applying the brakes.

SLIDING DOOR FASTENER.—H. M. VAN ALSTYNE, 50 Chestnut St., Rensselaer, N. Y. Among the objects of the invention is the provision of a construction to reinforce the sliding doors of freight cars. A further object is the provision of means whereby the door when moved to closed position can be very easily locked. The fastener is simple and strong, and requires a minimum of parts all of which are easily accessible.

Pertaining to Recreation

PAVEMENT GLIDE. — W. O. CARLEY, 831 N. 8th St., Walla Walla, Wash. The invention relates to roller skates or pavement glides. Its object is to provide a glider that will need two wheels only instead of four, and will thereby decrease friction, that will allow the wheels to be of larger diameter with a resultant higher degree of stability, that will provide a brake allowing the operator to come to a stop even when gliding down hill, and at the same time largely eliminate the danger of falling backward. (See Fig. 22.)

Pertaining to Vehicles

AUTOMOBILE LOCK. — J. H. FROST, 341 E. 136th St., New York, N. Y. This invention relates to a simple and inexpensive anti-shaft device for motor vehicles, and refers more particularly to a lock which covers the slot of the emergency brake, and which when in operative position coacts with the lever of the brake to retain the same in braking position. The device prevents unauthorized shifting of the brake when locked, but does not prevent the car being pushed, in case of fire. (See Fig. 23.)

DUMPING BODY. — W. H. MAHLOW, R. F. D. No. 4, Trenton, N. J. The invention aims to provide a dumping body particularly adapted for use in connection with vehicles such as are utilized for the transportation of coal, sand, etc. The primary object of the invention is to provide a body capable of being moved with respect to the supporting member so that it assumes a dumping position, the body being moved to this position by means of mechanism of extremely rugged and simple construction.

BODY FOR CHILDREN'S VEHICLES. —D. A. CAMERON, c/o J. F. Hambilzer, Houghton, Mich. The invention relates to a top or body adopted to be applied to a sled or the running gear of a baby carriage, and having the general character of the body of a closed automobile. The general object is to provide a body arranged for the convenient placing and removal of a child, with ample provision for a supply of fresh air, the front portion, representing the engine, being used as a storage box.

DIRECTION INDICATOR.—O. C. KNIGGE, 146 W. 25th St., New York, N. Y. Among the objects is to provide means by which the contemplated direction of travel of a motor vehicle may be signaled to drivers of other vehicles, and to provide a device in which the signal may be given at a time before the actual operation of change in direction of the vehicle is performed, the device also indicates the intention of the driver to stop. The signal may be used by night or day.

SUPPORT FOR VEHICLES.—J. E. HANCOCK, c/o Charleston Chemical Co., Charleston, S. C. An object of the invention is to provide a support or cradle adapted to support an automobile with the wheels out of contact with the ground, which is automatic in that the car may be elevated by simply running it into the cradle under its own power, the automobile supplying the power necessary to actuate the cradle in the elevating operation. (See Fig. 24.)

PROTECTIVE VENTILATING SCREEN FOR VEHICLES. — B. A. DANIELS, c/o Bochardt & Bochardt, 508 Citizens Bank Bldg., Tampa, Fla. An object of this invention is to provide a simple and practical device which is adapted to be detachably secured to a vehicle to protect the occupants of the vehicle from insects, missiles, and other flying objects, such as gravel dust and the like. A further object is to provide a device which in its applied position will not obscure the vision or in any way interfere with the operation of the vehicle. (See Fig. 25.)

TOOL FOR REMOVING FROM OR APPLYING DIFFERENTIAL GEARS TO THEIR AXLES.—W. C. BAKELS, Midland Park, N. J. An object of this invention is to provide a tool for expeditiously removing or associating a gear with its axle by forcing the same into or out of place, thereby eliminating the necessity of hammering or pounding the same. The tool is strong and simple, and particularly adapted for use in repair shops or garages having means for associating the same with an ordinary bench vise. (See Fig. 26.)

REENFORCING STRIP FOR TIRES. —M. B. PEEPLES, Scotia, S. C. An important object of this invention is to provide a strengthening or reenforcing strip between the flange of the rim and the bead of the tire so that the flange cannot come in direct contact with the bead of the tire and so as to effectively exclude sand, water and the like. The reenforcing strip may be applied by a vulcanizing process or may be placed in position at the proper place and remain separate from the tire.

WHEEL.—R. G. BRUNER, 935 Moy Ave., Windsor, Ontario, Canada. The invention relates more particularly to a spring or resilient wheel possessing relatively high cushioning capacity and in which the springs which are not under load at any given time do not increase the stresses imposed upon the springs under load, at the same time being adapted to immediately come into action when moved into position to be subjected to load. The parts are readily accessible for purposes of cleaning, replacing and repair.

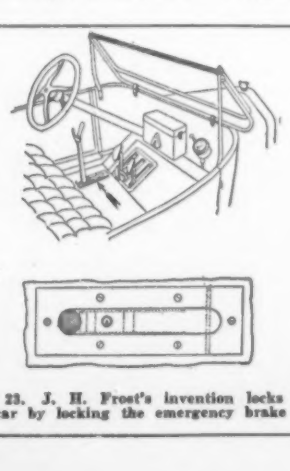


Fig. 23. J. H. Frost's invention locks the car by locking the emergency brake

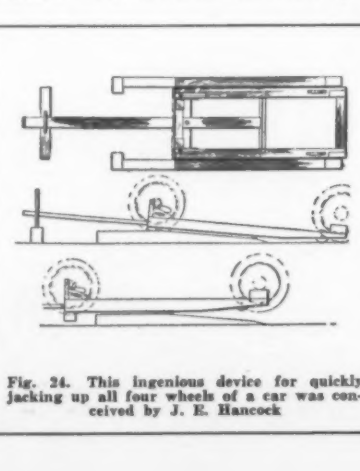


Fig. 24. This ingenious device for quickly jacking up all four wheels of a car was conceived by J. E. Hancock

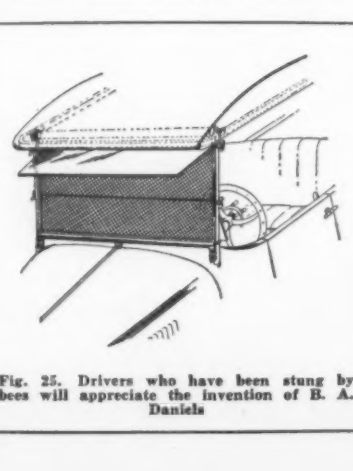


Fig. 25. Drivers who have been stung by bees will appreciate the invention of B. A. Daniels

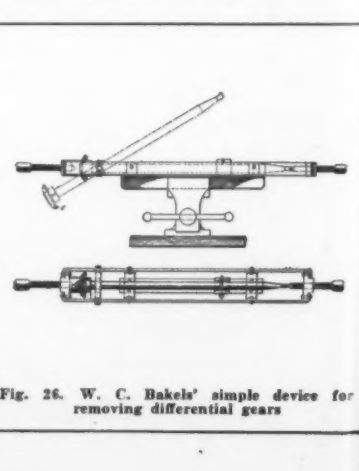


Fig. 26. W. C. Bakels' simple device for removing differential gears

Chemical Processes

COMPOSITION FOR IMPREGNATING WOOD AND PROCESS OF PREPARING IT.—G. GOESTER, c/o Georgia Vita Ligno Co., Brunswick, Ga. This invention aims to provide a process and substance whereby wood, after being treated with such substance, will become immune from the attacks of destructive animal life for an unlimited length of time, even though submerged and at times exposed, as, for instance, at low tide, to the air. The mixture consists of coal oil, bone oil, and crude carbolic acid, heated that they may be condensed to get rid of the ammonia vapors.

Of General Interest

METER BOX.—C. W. BLUE, c/o Messrs. Janney & Co., Montgomery, Ala. The object of the invention is to provide a meter box closure of simple and strong construction which may be securely locked at a plurality of points and which cannot be unlocked except by a key of peculiar construction, and which when unlocked cannot be removed until rotated to certain defined positions, thus making it highly improbable that the closure will be removed by an unauthorized person.

PAIL CLOSURE.—S. M. JOHNSON, c/o The Ohio Pail Co., Middlefield, Ohio. The invention particularly relates to the type of pail employed for storing or shipping paint or the like in which the closure must be securely held against displacement. The primary object is to provide a closure which is adapted to be crimped for securing the same to the pail and in which every possibility of unintentional displacement is eliminated, yet the closure is easily removable when desired.

LAZY TONGS.—J. G. CORNELL, 988 Hancock St., Brooklyn, N. Y. The general object is the provision of a simple and durable mounting for associating the different members of the system. This is accomplished by providing a common shaft on which a pair of the bars of each of the two sets of bars is rotatably mounted, interposing between the bars of the different pairs a bearing, and mounting on the shaft means for forcing the bars toward one another to compensate for wear.

COOKING DEVICE.—M. KOTT, 280 E. 10th St., New York, N. Y. The general object of this invention is to provide a device in which food may be cooked without the use of grease or any means for preventing it from sticking to the cooking vessel. A further object is to provide a drum in which means for supporting the food to be cooked is located, and rotatable means so that when placed above a source of heat a continual change of area is directly in line with the flow of heat.

CLASP.—L. JABNER, P. O. Box 1665, Station C, Los Angeles, Calif. The invention aims to provide a simple and rugged separable fastener for jewelry which positively insures against accidental separation and resultant loss of the article. A further object is to provide a clasp which functions to permit of relative rotation of the elements whereby the same act as a swivel. A still further aim is to produce a minute device without detracting from its strength.

CRIB COVER.—E. M. DREW, Blanchard Bldg., Barre, Vt. The primary object of the invention is to secure the covers for children's cribs in such a manner that the covers will not be displaced relative to the crib or the occupant thereof upon restless movements, the occupant being free to turn upon one or the other side without disarranging the covers, yet the occupant may be removed and replaced in the crib without disturbing the covers.

METER CONSTRUCTION.—E. A. KERSTEIN, 447 Delaware Ave., Albany, N. Y. The invention relates more particularly to gas meters. An object is to provide a meter of the general conventional type, the parts of which will be modified to virtually preclude distortion or displacement of the crankshaft. A further object is to provide a slide valve actuator, in association with the base of the meter casing in such manner that the base may be readily removed for purposes of renewal, etc.

FOLDING SEAT.—A. TRUFFY, 15 Impasse Parmentier Courbevoie, Seine, France. This invention has for its object to provide a seat characterized by the features that the legs of the seat constitute the branches of a jointed X, one of the branches being pivoted to the seat, the other to the back, which latter is likewise pivoted to the seat proper, the locking of the branch to the back effected by a suitable device.

DOUBLE-FACED CHANGEABLE-LETTER SIGN.—J. G. WILLIAMS, 142 E. 47th St., New York, N. Y. The object of the invention is to provide a simplified sign capable of receiving different sized letters without adjusting any of the parts, and so arranged that any desired size may be readily applied or removed from either front or rear face of the sign, the size being formed of built-up sections with means for engaging and holding the letters in place.

ROLL FILM HOLDER.—J. A. KNORR, 26 Cortlandt St., New York, N. Y. An object of the invention is to provide a film holder for moving picture cameras which may be readily attached when in use to act as means for supplying unexposed film or as a reel for receiving exposed film. A further object is to provide a holder with a hub structure acting in the double capacity of a reel member and a clutch for interlocking with driving mechanism.

MOTION PICTURE CABINET.—A. G. MERRIMAN, 416 Dodge St., W. Lafayette, Ind. The invention relates to cinematographic apparatus. An object is to provide an ornamental cabinet which comprises a casing having a translucent screen in one side and means disposed interiorly for occasioning the reflection of images of pictures upon the screen. A further object is to provide means for preventing the overheating of combustible elements comprised in the apparatus.

APPARATUS FOR TURNING DEEP-WELL BITS WHEN BEING SHARPENED.—J. G. SCHOOLEY and H. M. RANSDELL, Tulsa, Okla. The object of this invention is to provide means whereby the turning of a bit upon an anvil may be easily accomplished with a minimum of labor and without the possibility of being burnt. The invention provides a novel form of pulley with a chain and a U-shaped supporting member adapted to be used in conjunction with the apparatus.

LOGGING HOOK AND LINK.—L. E. PARKER, Pe Ell, Wash. The primary object is to provide means for detachably connecting separated elements together in such manner as to normally prevent the parts from being accidentally disconnected. A further object is to provide a hook formed with no relatively movable parts and a link adapted to engage the hook when in a certain position, and prevented from disengaging when in any other position.

LOCKING HINGE.—K. O. GOBER, 3025 Richmond Ave., Oakland, Calif. The particular object of this invention is to combine with a hinge commonly used as a locking device by means of which the hinge may be prevented from swinging on its pivot. The device comprises a slot in one strip of the hinge and a rigid member secured to the other strip having a projection, and means for locking the projection to the slot.

BOILER TUBE CUTTER.—M. MAHER, c/o National Boiler Works, Water St., foot of McKinley Ave., Bay City, Mich. The general object of this invention is to provide a boiler tube cutter which is of simplified construction. The device comprises an elongated body adapted to be inserted into a boiler tube, and a circular cutter so constructed as to move radially outward so that the cutter will sever the tube, on the turning of a handle.

UNIVERSAL WOODWORKING TOOL.—J. H. BLOODGOOD, c/o Wizard Mfg. Co., Box 1312, Tampa, Fla. A purpose of this invention is to provide a motor-operated woodworking tool which permits of the substitution of various forms of tools thereto, so that all the major operations in the working of lumber incident to the construction of wooden buildings can be performed with one and the same tool. The tool can be arranged to accommodate itself to a right or left-handed operator.

ADJUSTABLE JAMB UNIT.—C. F. BIELE, 379 W. 12th St., New York, N. Y. This invention relates to an adjustable metal jamb unit for fitting into a doorway where the wall opening lacks the proper accuracy of dimensions to suit the intended door, as in the case of built-in tile doorways in tile bathrooms and other situations. The general object is to provide a jamb unit composed of elements embodying strength and simplicity.

LOCK.—J. MANN, 348 E. 125th St., New York, N. Y. An object is to provide a construction which may act in the ordinary capacity of door locks or may act in conjunction with a link as a safety catch for a door when ajar. Another object is to provide a locking structure with a locking bolt and a link pivotally mounted on the keeper arranged to co-act with the bolt to present a link safety device for holding a door partially open and at the same time locked.

CREMATORY.—A. C. FELTON, JR., Macon, Ga. An object of the invention is to provide a crematory which affords facilities for utilizing in the incineration practically all the heat generated within the crematory. A further object is to provide a simplified construction which embodies an arrangement whereby fuel may be readily fed to the combustion chamber and the heat conducting passages of the crematory conveniently cleaned.

PNEUMATIC SUPPORT.—G. JORDAHN, Palm Beach, Fla. This invention relates to pneumatic supports especially adapted for use in the water, but may be readily applied for other uses, as, for instance, pneumatic cushions for vehicles or for mattresses. More particularly the device is constructed for teaching the art of swimming, or for use as a float employed in the water, at the same time retaining the advantages in respect to assistance in learning to swim.

STERILIZING CONTAINER.—G. M. GROSS, Eldorado Springs, Mo. An object of the invention is to provide a container having a plurality of compartments, each separate from the other, and each being adapted to permit of instruments to be sterilized or kept in a sterilized condition, and being removably disposed therein, the cells being removable from the outer casing for cleaning or other purposes.

TRAP.—L. C. ACCOLA, Canton, Mo. Among the objects of this invention is to provide a trap in which the clamping jaws also act as an actuating spring means, and in which the jaws are locked in closed position when the trap is sprung, means being provided for varying the spring tension. The device is durable, of simple construction and not likely to easily get out of order.

FILM DRIER.—J. W. HICKS and W. W. HICKS, 2815 14th St., N. W., Washington, D. C. The invention relates to driers especially adapted for drying photographic films. An important object is to provide a drier having means whereby a constant circulation of heated air is maintained, and having a plurality of slidably supported racks with means whereby they may be readily positioned exteriorly of the drier so as to permit of the rapid hanging of removal of the strips of film carried thereby.

PIN CLASP.—J. ZANGRILLI, 214 E. 126th St., New York, N. Y. This invention relates to devices purposed to retain the corners of soft collars and the like; among the objects is to secure retention without undue strain, to facilitate the insertion and removal of the pin-clasp, to make it possible to leave the holder securely engaged with one corner for future use, while embodying features of extreme inconspicuousness and simplicity of structure.

CLEANING STICK.—H. W. ROUTSON, 3406 Andover St., Oakland, Calif. The particular object of the invention is to provide convenient means for holding a scouring element such as steel wool in combination with means for saturating the scouring means with soap or a similar cleaner while the same is being used. The device comprises a tube which is adapted to project the cleaning material as required.

ADHESIVE.—O. JOHNSON, c/o Johnson, Waterproof Glue Co., 60 California St., San Francisco, Calif. The invention relates to the process of making an adhesive composition which consists in extracting the oil from the soya bean, grinding the residue, and then adding to the finely ground residue hydrated lime and sodium fluoride, in about the following proportions; three parts lime, one part sodium fluoride, ten parts bean, and water to desired consistency.

VANITY CASE.—W. H. DENNEY, Metropolitan Tower, 23rd St., New York, N. Y. The invention has for its object the provision of a twin compact container of the convenient circular type with an upper and lower compartment in which the regulation size of compact is arranged with an applicator or puff for each, the compartments may be used simultaneously and a convenient mirror is supported by the cover.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. Among the objects of the invention is to provide a vanity case constituting a main receptacle having an auxiliary receptacle hingedly connected thereto and swinging laterally therefrom. A further object is to provide a hinge by means of which a laterally-swinging receptacle may be pivotally mounted on the main receptacle by the same hinge which forms the pivotal mounting of the cover.

ANIMAL TRAP.—J. W. PRIMROSE, c/o Mrs. S. W. Harlison, 112 No. Hinds St., Greenville, Miss. The invention relates to traps for catching rats, mice and the like, the object is to provide a trap of the ever-set type, being always open for the entry of the rodent except immediately after an animal has entered and has closed the entrance prior to passing into the retaining chamber, the device being free of all mechanism within the entrance prevents fright on the part of the animal.

SHOE DRESSING.—S. CASSISA, 314 New York Ave., Brooklyn, N. Y. Among the objects is to produce an inexpensive dressing of the non-lustre type, adapted for use on canvas and suede shoes which will not render smooth the surface of the shoe, but preserve its original appearance. The dressing contains plaster of paris, starch, magnesium oxide, sugar, borax, perfumed glycerine and water to produce a paste.

SPACER FOR PAVING BLOCKS.—W. P. WHITNEY, 2600 E. Ash St., Springfield, Ill. The object of the invention is to provide a spacer which may be easily and quickly applied to a paving block of concrete, creosote, or the like, or to a paving brick previous to the setting thereof for holding the same properly spaced for pouring or otherwise inserting a filler such as tar and sand.

COMBINATION BILLING SYSTEM.—R. V. NEWSHAM, 369 Pine St., San Francisco, Calif. This invention has reference more particularly to a combined form which will enable an office transaction to be accounted for in one operation on a typewriter to leave the original bill a so-called expiration record and a copy of the original bill for collection purposes.

AMPLIFIER.—R. P. SILVERTHORN, 222 So. State St., Marion, Ohio. An object of the invention is to provide an amplifier which is so constructed that it will bring out tones otherwise lost in the playing of a record. A further object is to provide means for suspending the amplifier directly under the tone arm of a phonograph so that the amplifier does not contact with the cabinet and cabinet vibration is entirely done away with.

TELESCOPE.—M. LICHTMAN, 172 E. 93d St., New York, N. Y. Among the objects of the invention is to provide means whereby a plurality of telescoping sections can be fitted and constructed to slide with respect to one another by the use of a minimum number of parts in the construction, which greatly enhances the simplicity of the device, and produces a compact telescope, which is economical to manufacture.

SLIDE RULE.—C. N. REYNOLDS, JR., 131 Rochambeau Ave., Providence, R. I. The general object of the invention is to provide a means for illustrating the implications of Einstein's restricted theory of relativity. The object is accomplished by providing a rule, including slides, which has a plurality of scales marked thereon for illustrating the apparent effect of the uniform relative motion of two observers upon their respective units of time and space.

LOOSE LEAF CONNECTION.—F. L. MAETIN, c/o A. W. Swiezy, 4 Bond St., New York, N. Y. The primary object of this invention is to provide a loose leaf connection for detachably associating the leaves of pages to a binder which eliminates the necessity of employing bolts, split rings, or other standard forms of separable fastening elements for this purpose. As a further object the invention aims to produce a simple and inexpensive connection in the form of resilient clips.

DISPLAY BOX.—A. K. HARNED, 161 W. 105th St., New York, N. Y. The invention more particularly relates to losses for displaying or exhibiting flat goods such as handkerchiefs, underwear and the like. A specific object is to provide means whereby an ordinary box can be converted into a counter or show case without changing its construction and without removing the contents or disturbing the original package.

LIFTING DEVICE.—J. BURKLEY, 4248 No. Drake Ave., Chicago, Ill. The invention relates to a lifting device primarily for use as a kitchen utensil. The general object is to provide a lifting device which may be positioned in a cooking utensil to support

the article of food being cooked so that after cooking the food may be removed from the cooking utensil, retaining it in its original shape.

RECEPTACLE.—I. LEVY, c/o Nickthausen & Levy, 252 Java St., Brooklyn, N. Y. One of the objects of this invention is to provide a device especially adapted for containing cakes and similar perishable foods, the device being constructed with sliding doors giving access to the compartments in which the articles are adapted to be placed. The device is simple of construction, and easy of operation, and can be manufactured at a reasonably low price.

Machines and Mechanical Devices

INK DISTRIBUTOR.—D. V. KAUFMAN, 2 W. 117th St., New York, N. Y. An object of the invention is to provide an attachment for printing presses which may be bodily applied and removed without injuring the attachment or the press. A further object is to provide an ink distributing construction whereby all parts of a sheet may be supplied with an even quantity of ink and thereby cause pictures and other representations requiring an appreciable amount of ink to all appear alike when printed.

MOLDING MACHINE.—P. DHE, 49 Rue Notre Dame des Champs, Paris, France. The invention relates to a molding machine for the purpose of giving to the peripheral part of a molded article an exactly determined height no matter how irregular may be the quantity of plastic material introduced into the mold.

DISHWASHING MACHINE.—U. S. G. WELSH, 90 Prospect Park West, Brooklyn, N. Y. Among the objects of the invention is to provide means for directing the water effectively onto the dishes in the receptacle of the machine, and means for agitating the water and directing the water upwardly along the sides of the container, the cover being so formed as to direct the water continuously inwardly and downwardly.

PUMP.—M. P. FERRER, 357 Hamilton Ave., Brooklyn, N. Y. The general object is to provide a pump for pumping viscous substances whereby the flow of the material will be facilitated. A further object is to provide a steam jacketed pump cylinder for the heating of the viscous material and to utilize the steam as a motive fluid for turning the pump.

DOUGHNUT MACHINE.—C. A. PURDY, 5825 Wayne Ave., Chicago, Ill. This invention has for its object the provision of a device in which the amount of dough forced through the cutting die may be varied to produce thin or thick doughnuts. A further object is to provide a machine in which the dough is first drawn into the device and then forced through the die.

METHOD AND APPARATUS FOR SEPARATING MATERIALS.—J. A. RICE, 1165 Arch St., Berkeley, Calif. This invention relates to centrifugal ore separators, and more particularly to a form of "trap" by means of which the heavier parts of the crushed ore may be separated from the ore and discharged in a simple and reliable manner. An object is to provide a separator which may be easily operated and with which large quantities of ore may be treated at a low cost.

PUMP.—L. L. INGRAHAM, Gooding, Idaho. The object of the invention is to provide a pump adapted for elevating liquids when submerged in a body of water and having a relatively high pumping capacity. It is also an object that the parts be simple and not subject to get out of order, and that the pump be adapted to operate at a very low speed, at the same time deliver a large volume of liquid.

ROAD MACHINE.—K. CHRISTENSON, Benedict, N. D. Among the objects of the invention is to provide a machine which is adapted to carry out road building or repairing operations, which is effective in operation to loosen, distribute and pack the material constituting the roadway, which is flexible in its action, easily controlled and of simple and durable construction.

GLASS WASHING MACHINE.—F. T. BURNHAM, c/o Burnham Bush Straw Mfg. Co., Newton Center, Mass. The invention contemplates a comparatively simple machine which is especially designed for handling large quantities of glasses, cups, dishes or similar containers in soda fountains, restaurants or the like to thoroughly clean the articles. Among the principal objects are to provide a machine for saving time and labor, which is automatic in its operation, self-contained and thoroughly efficient, and can be controlled by a person without knowledge of mechanical devices.

SCALE ATTACHMENT.—F. R. WAINWRIGHT, 258 Jewett Ave., Jersey City, N. J. The aim of the invention is to provide a device which may serve as a display or advertising medium for any conventional type of scale, subsequent to its manufacture, or to be applied at the time of manufacture and will be actuated by the movement of the scale mechanism in such manner that persons will notice the advertising or display matter.

ELEVATOR.—J. G. CORNELL, 988 Hancock St., Brooklyn, N. Y. The general object of the invention is the provision of an inexpensive, simple and durable elevator of the lazy tongs type provided with balancing means that may be located below the elevator cage and which is attached to the lazy tongs system. A further object is the provision of an elevator for mounting in floors or sidewalks, provided with equalizers for adjusting the operating chains on the driving mechanism.

WASHING MACHINE.—F. K. RENNER and E. C. PFAFF, c/o F. K. Renner, 4654 N. St. Louis Ave., Chicago, Ill. Among the objects of the invention is to provide a washing machine embodying means for causing the circulation therethrough of a cleaning fluid and a continuous flow to the cleansing fluid through articles disposed within an oscillatory receptacle. A further object is to provide a device having means for draining the liquid compartment so that the cleansing fluid may be changed at will.

ADVERTISING DEVICE.—F. R. CHESTER, c/o Chester Pollard Co., 1416 Broadway, New York, N. Y. This invention relates to a mechanical device wherein soapy water is blown into bubbles which are allowed to fall in a cascade, means being provided for illuminating the bubbles, while in continuous movement, the bubbles bursting and returning to a liquid, which is again blown into more bubbles, the effect produced being pleasing and ornamental.

WATER CARRIER.—H. J. DANIEL, Sutherlin, Va. An important object of the invention is to provide a simple and reliable means whereby water may be carried from a spring to a house or other point of use without the necessity of going to the spring and manually filling the carriers. A further object is to provide a monorail structure having convenient means whereby a truck is held upon the rail at the end of its movement and when the buckets of water have been removed.

JUSTIFYING DEVICE FOR TYPEWRITERS AND THE LIKE.—K. C. O'BRYAN and J. W. O'BRYAN, 36 Bryant St., N. W., Washington, D. C. This invention relates generally to typewriting machines, and more particularly to attachments having for their purpose the justification of lines of typed matter and the graduated spacing of characters in a line, the invention being applicable to typewriters, stencil cutters and other key actuated devices having movable carriages and a normally unadjustable escapement control for the carriage.

WATER CONTROLLING DEVICE.—T. CURRAN, 5643 S. Peoria St., Chicago, Ill. An object of the invention is to provide a water controlling device for turning on and off the flow of water in a water main and which is operated by the water pressure within the main. A further object is to provide a controlling device for railroad standpipes permitting the use of a gate valve which provides a free way flow of water to the standpipe.

CHUCK.—I. T. NEDLAND, Hillsboro, N. D. This invention particularly aims to provide a chuck preferably for a watchmaker's lathe, for securely and adjustably holding a finger ring with its circular band anchored within the chuck and behind an enlarged portion of the band to be machined by applying a suitable lathe tool to the enlarged portion to turn out a so-called flat-top basket stone-mounting.

CENTRIFUGAL CASTING MACHINE.—J. D. HAMMOND, 1604 1st St., Jackson, Mich. The invention relates to die casting machines in which molten metal is introduced into a revolving flask by centrifugal force. A further object is to provide a device in which a pouring device for introducing metal into the flask is actuated by a mechanism rotating at a predetermined speed.

CLOTH-LAYING MACHINE.—G. SOYLIAN, 40 Wyckoff St., Brooklyn, N. Y. An object of the invention is to provide a construction which will be automatic in its actions of laying successive layers of cloth in a given space. A further object is to provide a machine with a traveling carriage and gripping means at a predetermined distance apart, the arrangement being such that the carriage travels from one gripping means to the other, back and forth, and automatically lays the cloth as it travels.

ELEVATOR SYSTEM.—W. GROMER, 36 8th St., Woodside, L. I., N. Y. The principal object of the invention is to provide an elevator system involving the use of a plurality of cages and guides, supporting and controlling means therefor, whereby a cage is not limited to ascents and descents in a single shaft, but is also shifted horizontally at different levels for transport from one shaft to another, and a considerably greater number of passengers transported in a given period than in previous systems.

PISTON RING.—J. H. BRENNER, Douglas, Wyo. The object of this invention is to provide a piston ring which is adapted to expand and contract by the pressure formed between the ring and the piston by the leakage of oil, air or other fluid or gaseous mixture within the cylinder so as to give a proper joint against leakage in both directions of movement, at the same time provide a ring which can be very easily applied and removed in the ordinary way.

ELEVATOR FOR SUCKER RODS.—N. A. JANNET, 208 E. Main St., Ranger, Texas. The invention relates to devices for use in handling tubes and sucker rods in deep wells. An object is to provide a device which can be readily adjusted to a sucker rod to support the same in a desired position and to prevent rotation of the rod. A further object is to provide means whereby accidental displacement of the sucker rod is precluded.

TESTING APPARATUS.—C. R. HILL, Box 82, Van Wert, Ohio. An important object of the invention is to provide an apparatus for determining the setting time of cement, plasters, or other compositions possessing the property of hardening, the purpose being to enable the determination of the interval of time elapsing between the compounding of the cement and the hardening of the same. The apparatus is simple in its operation.

CONVEYOR.—W. H. ONION, 2518 Canal St., New Orleans, La. The purpose of the invention is to provide a conveyor of the endless belt type for handling heavy or light articles with equal efficiency, which is comparatively inexpensive to install, durable and consisting of few parts which are adapted to operate in a smooth manner, and with a minimum amount of friction of the movable parts.

COLLAR BURSTER AND EXPANDER.—J. A. WOODS, c/o Holmes, Yankley, Holmes & Eaton, 506 4th National Bank Bldg., Wichita, Kans. An important object of the invention is to provide a collar burster having simple means whereby the same may be introduced into a well casing and securely and positively engaged with a collar to be expanded so that the section of casing immediately below the collar to be burst may be parted from the sections of casing above.

ANTIFRICTION ROLLER BEARING.—J. T. RICE, R. A. RICE and J. A. RICE, 1713 Unionport Road, Bronx, N. Y. The general object of the invention is to provide a bearing of the type that will prevent the entrance of dirt to the rollers, and race for latter, or at least minimize the entrance of dirt, as well as to provide a construction making for facility in the assembling and disassembling of the parts.

MIXER.—T. G. DEMPSEY, 723 E. 163rd St., New York, N. Y. The invention is primarily designed for use as a concrete mixer. The general object is to provide a mixer with means for giving the ingredients to be included in the mixture a helical movement as they pass through a casing to mix them. A further object is the provision of a device for mixing dry mixtures which continuously delivers the mixture, and means for applying water to the dry mixture as it leaves the machine.

MACHINE FOR MAKING RETAINING RINGS FOR RECEPTACLE CLOSURES.—A. VAN A. FELTEN, 38 Morris St., Danbury, Conn. Among the objects of the invention is to provide a machine in which retaining rings for receptacle closures may be readily and economically constructed and in which a strip of material is flanged along its longitudinal edges and then bent into the form of a ring with the intermediate or web portion in a plane transverse to the axis of the ring.

OIL-SAVING STACK FOR GAS-FLOWING WELLS.—E. R. AUSTIN, c/o O. A. Arnold, Box 447, Breckenridge, Texas. The invention relates to a device for application in connection with gas-flowing oil wells. Its object is to recover from such gas the minute particles of oil carried in suspension therewith and which ordinarily escape and are lost. A further object is to provide a construction which may be readily inserted and removed from effective position over a standpipe, and which may be readily cleaned from time to time.

SPRAYING MACHINE.—J. PASCHALL, 1411 W. Madison St., Chicago, Ill. This invention is particularly designed for spraying paint, calcimine or analogous material over relatively large flat surfaces. An object is the provision of a device by means of which the material may be evenly spread in a minimum amount of time, and in which the quantity and density of the material may be regulated as desired in treating cracks, crevices or inconvenient places.

GIN RIB.—F. B. COMPSTON, Blooming, Texas. The invention relates to means for increasing the ginning capacity of cotton gins. An important object is to provide a cotton gin having a plurality of revolving ribs which move between the gin saws and double the ginning capacity but do not affect the usual operation of the gin.

MILLING-MACHINE CUTTER.—J. MATTSON, 1834 N. Rockwell St., Chicago, Ill. This inventor has been granted three patents of a similar nature, their object is to provide milling-machine cutters which are adapted to cut a piece of work faster than the ordinary cutter without sacrificing the uniformity of cut which is accomplished by the ordinary cutter. A further object is to provide a device which makes use of circular and non-circular cutters and in which the cutters may be readily secured and clamped in position, and provide means whereby the cutters may be turned, whereby the same cutter may be used for a relatively longer length of time.

CLUTCH.—D. W. WOOD, Brazil, Ind. The invention relates to cone type clutches, its object is to provide a clutch arranged to insure accurate and quick coupling or releasing of the driving and driven members. Another object is to provide a clutch more especially designed for use on the countershaft of high-speed tooling machines to readily overcome the momentum when the clutch is thrown into reversing position, thus reducing the wear of the working members.

GRINDING AND BORING MACHINE.—V. BARTLEY and J. B. WORTHINGTON, c/o Automobile Service Works, Oklahoma City, Okla. The invention aims to provide a grinding and boring machine particularly adapted to use in connection with cylinder blocks, by means of which even badly mutilated cylinder interiors may be readily reground and finished. The device is simple, and means are provided for supporting the work to avoid undue strains.

GUIDE FOR GRINDING DEVICES.—M. P. SCHMITT, 1619 Sheridan Rd., North Chicago, Ill. The invention particularly relates to grinding devices used for the sharpening of lawn mower blades and the like. An object is to provide a guide for grinding, in which the depth of the cut about to be made may be accurately determined and in which variation in the grinding of a straight blade due to the elastic properties of the grinding wheel support is reduced to a minimum.

PUMP PISTON.—T. W. DELANEY, 691 Aurora Ave., St. Paul, Minn. The general object of the invention is to provide a double-acting deep well pump in which plungers are provided one above another, and to provide simple operative parts characterized by the minimum friction in operation, and discharging the liquid in practically a constant stream. The invention provides a simple form of mechanically operated valve in the plunger with an arrangement of air chamber directly above the cylinder.

APPARATUS FOR CLEANING THE OUTSIDE OF BOILER TUBES.—F. KOBER, 3 Dombergsweg, Sulh, Germany. This invention is particularly intended for cleaning scale from tubes, for instance the fire tubes of boilers of portable engines. The apparatus comprises a portable operating mechanism, and an endless band or chain having cleaning tools attached, said band or chain being adapted to pass around the tube; the device may be used on the middle tubes of a bundle of tubes.

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The Animal Hospital

(Continued from page 318)

period of work. The largest number of cases always occur just after a holiday that falls on Monday, when horses have been idle. Prevention, according to Dr. Klein, is merely a matter of reducing the rations and taking the horse for a walk. In a single year Azoturia killed 27 horses out of 50 cases.

Influenza is the next most common disease to which horses are subject, judging by the records of this hospital. In one year 36 cases were reported to the medical clinic. The percentage of cures there is much higher, only five of the number being lost. Hogs also are subject to a form of the same disease familiarly known as "hog flu." Swine are rarely brought to the hospital, most of the treatments being given by the Ambulatory Clinic, which is a traveling hospital, fully equipped for all sorts of medical treatment and minor surgical work. It covers a wide territory in the rich farming regions around Philadelphia, and an idea of the extent of its work may be gained from records showing a total of 3,413 cases treated in a year, including 60 horses, one mule, 2230 cattle, 1115 swine and seven dogs.

The widely expanded scope of the medical work now being done for animals may be indicated by figures from still another department of this hospital—the free dispensary for large animals. Its last annual report shows a total of 626 cases treated, under two classifications, external and internal. In the former were included diseases of the eye, head and neck, thorax and abdomen, anterior limb, posterior limb. The internal diseases included respiratory, digestive, nervous, skin, genito-urinary and miscellaneous. The hospital even prescribes for general debility for horses.

The clinic for small animals, however, touches a responsive chord in the hearts of those who love animal pets. It had 5252 cases last year. It trimmed the beaks of pet birds, operated on a dog for concussion of the brain and kept him alive, removed foreign bodies from the eyes, throats and stomachs of cats and dogs, repaired all sorts of broken bones and put countless animals on proper diet. Every morning from 9 to 11 o'clock there is a long procession of pet owners filing into the hospital with dogs, cats, rabbits, monkeys and parrots under their arms. In 2929 cases it was necessary to keep such pets in the hospital for treatment or operations. Reference has been made to skunks. Strange as it may seem, many persons take a liking to the looks of these beautifully striped but odoriferous little animals and decide to keep them for pets. In order to make that possible the only thing necessary is to have the scent glands removed, after which the civet cat is powerless to use his chief weapon.

In his years of experience Dr. Klein has made many discoveries concerning the cause of common ailments in pets. He is authority for the statement that a large number of the digestive and stomach troubles of dogs is due to improper feeding. Even among dog lovers who are presumed to know something about methods of feeding the animals, there is a widespread belief that meat is likely to cause fits. Therefore all sorts of substitutes are tried, and since it is possible to make a dog eat almost anything if he is hungry enough, trouble results.

"The dog is a carnivorous animal," says Dr. Klein. "Meat is his natural food. It can't hurt him, unless, of course, he gets too much, when he is inclined to gorge. Even that will not do as much harm as feeding him vegetables and other foods which his digestive organs were never designed to assimilate. Dogs have less intelligence than cats in the matter of food. A cat is less likely to overeat, or to eat the wrong foods, even when it has the opportunity. The mule, likewise, has more food sense than the horse. It would be possible to put 15 mules in a corral with just enough food for fifteen, and with some assurance that each would get enough. But if that were tried with 15 horses some, eating quickly, would get more than their share and overeat."

All animals dying or killed in the hospital are dissected by the students or instructors, except where the owners want them returned. It has been found that the most humane way to kill large animals is by shooting, and a special gun has been designed for the purpose. Its muzzle fits into the forehead of the animal, a pin is pressed and the bullet, long but not of large calibre, plows through the brain. Cats so badly injured or so diseased that they cannot be cured are killed in a glass topped box filled with gas.

This Week marks the Twentieth Anniversary of the Truscon Steel Company. As a compliment to business executives Truscon has summarized the experience it hasgained during these two decades in the field of standardized and simplified building, and is presenting itto them in convenient form. Thesefourbrochures tell Truscon's story completely. Complimentary copies sent on request.

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Automotive

The Increasing Average Life of the Automobile.—Two years ago figures were published tending to show that the average life of automobiles was about 5⅛ years. A compilation just completed shows the life of the cars that were manufactured from the fall of 1911 to the fall of 1915 to be about 6¾ years. The statistics on which this result was predicated may be regarded as fairly accurate. The increase in average age is attributed to the fact that there has been no striking developments in body design or important changes in mechanical features since 1912, with the result that there is a smaller tendency to retire a car before it has worn out. Other causes are: the improvement of our roads, the multiplication of repair shops, the introduction of the flat-rate system of car repairing and the general education of automobile drivers.—*Automotive Industries*, 49:8, pp. 387-8.

A Cooler Motorcar in Hot Weather may be had, according to Dr. W. W. Coblentz of the Bureau of Standards, by applying aluminum paint to the under side of the top and a white reflecting paint to the upperside. The ordinary black automobile top absorbs about 90 per cent of the solar heat which reaches it and a large part of this heat reradiated on the under side. The effect is about the same as that which would be reproduced by having a hot water radiator in the top. The application of the two kinds of paints named should reduce the temperature inside of the car to that of natural shade such as is had under a tree. It was found that white paint is a better reflector and a poorer absorber of sunlight than aluminum paint, but the latter is far better for preventing the passage of long heat waves off at lower temperatures.

A Worm-driven Street Car has been constructed in England as an experiment and tests already made on it have given very satisfactory results. The silence in running was remarkable as nothing could be heard beyond the rolling of the wheels on the rails. A further advantage has been gained by the use of differential, in order to do away with slipping and grinding in rounding corners. By the use of ball and roller bearings throughout a saving in power of about 20 per cent is made. The car has two motors driving propeller shafts and worms on opposite ends, so that there is traction on both pairs of wheels.—*Tramway and Railway World*, 54:3, pp. 9-11.

The Gasoline Motor Rail-car. It has been found, whenever the gasoline rail-car competes with auto-bus lines that the former has finally won out. The bus lines cannot operate reliably in bad weather, and the public seems to prefer the smooth running gasoline rail-cars to riding on the highway buses. The buses have had no difficulty in taking the cream of the local traffic as long as they were in competition with regular steam service, but the advent of the gasoline motor has introduced an element of novelty that has proved attractive. The largest car of the rail type thus constructed has been placed in operation on the Chicago Great Western Railway. This equipment comprises a two-car train with a seating capacity of 74 passengers and a total weight of 61,000 pounds. The motive power is supplied by a 6-cylinder gasoline motor which develops 180 horsepower at 1250 revolutions per minute. Using four speeds forward, with normal engine speed, 43 miles per hour is possible.—*Railway Review*, 73:6, pp. 201-5.

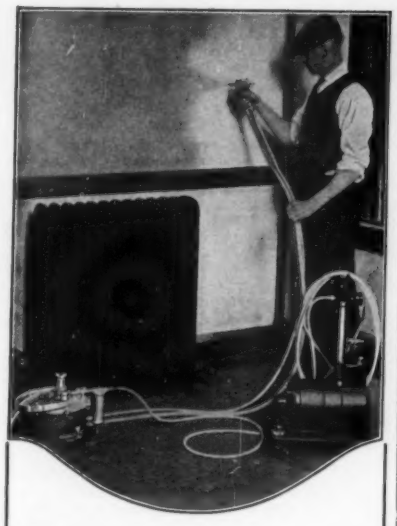
What May Prove to be an Epochal Move, bringing about extensive changes in existing laws relating to motor vehicle operation, and through these, important changes in motor vehicle chassis and body design, is the suggestion of a Yale professor as a result of his chemical investigations of the air in our large cities. It was shown that the air is being heavily polluted with carbon monoxide gas. The air effected by the exhaust of a moving car is in the shape of an elongated, horizontal cone extending some 30 feet back of the exhaust and from 5 to 15 feet above street level. Investigations recently made by Professor Henderson show that the contamination of the air in the more congested streets of New York often reaches the upper limit of a well-founded health standard, and sometimes exceeds it. To a great measure the carbon monoxide is generated as the result of carbureter adjustments that give maximum engine pull. The rich mixture wastes a third of the fuel value of the gasoline and generates much excess carbon monoxide in the exhaust. Buses contaminate the air for a distance of 100 to 200 feet behind them with three to four parts carbon monoxide. The suggested remedy is a vertical exhaust reaching the top of the car, above the level of the heads of passengers in vehicles following. The gases are therefore kept from being drawn into the wake of the car. The vertical exhaust is already being used by New Haven baker's trucks in order to protect the bread.—*The Automotive Manufacturer*, 65:4, pp. 27-8.

Tests of the Tractive Resistance of Pavement Surfaces were made in order to ascertain the relative cost of operation of motor vehicles on concrete, on gravel and on a non-rigid type of pavement. On each test a distance of 100 miles of continuous operation was run at speeds between 20 and 30 miles per hour. The conclusions were that between concrete and the non-rigid or bituminous type of road there is practically no difference in gasoline consumption. On gravel or macadam roads in good condition the gasoline consumption is from 10 to 35 per cent higher. Under modern volume of traffic good roads pay for themselves in economy of gasoline consumption and in economy of tire and other wear and tear. On a road carrying 2000 vehicles per day the saving on gasoline affected by hard surfaced roads is about $4000 per mile of road per year. To this must be added the wear and tear on tires and other parts, which must be as great as the cost of excess gasoline. To this must further be added the saving on road maintenance cost in order to get an object lesson on the economy of good roads.—*American City*, 29:2, pp. 124-5.

Civil Engineering

Broken Coral Reefs as an Aggregate for Concrete.—A resident of the Dutch West Indies has been experimenting with broken coral rock which abounds on the beaches of that region, with a view to its use in an aggregate for concrete. Thus far it has proved wholly satisfactory and has been used for the construction of floors, the covers for septic tanks, for drain pipes and for building purposes. In the case of a building that was to be constructed of such concrete, the material dug up in excavating the foundation proved to be sand and coral stones so well proportioned by nature that it was only necessary to add cement to it in order to have a first class concrete.—*Concrete*, 23:2, pp. 55-7.

Fourteen Billion Particles to the Cubic Inch represents the fineness of Portland cement, according to the estimate based on specially equipped investigations made by the Structural Materials Research Laboratory at Lewis Institute, Chicago. By means of an instrument known as an air analyzer a number of samples of cement were separated into groups of particles of different sizes. The average size of the largest particles in each group was then determined by microscopic measurements and from these measurements what are known as separation sizes were determined. Naturally, it is impossible to make



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an accurate estimate of the number of particles in a cubic inch of cement. However, from data gained from these tests with the air analyzer, it appears probable that about 6,000,000 cement particles could be placed in a single layer on a piece of glass one inch square. In a cubic inch, then, there would be approximately 14,000,000,000 of these particles, instead of only 40,000,000 or so that would occupy that space if all the particles were just small enough to pass through the openings of the 200-mesh sieve (.003-inch square) which is the size usually used in making the regular test of the fineness of cement.—*Cement, Mill and Quarry*, 23:2, p. 42.

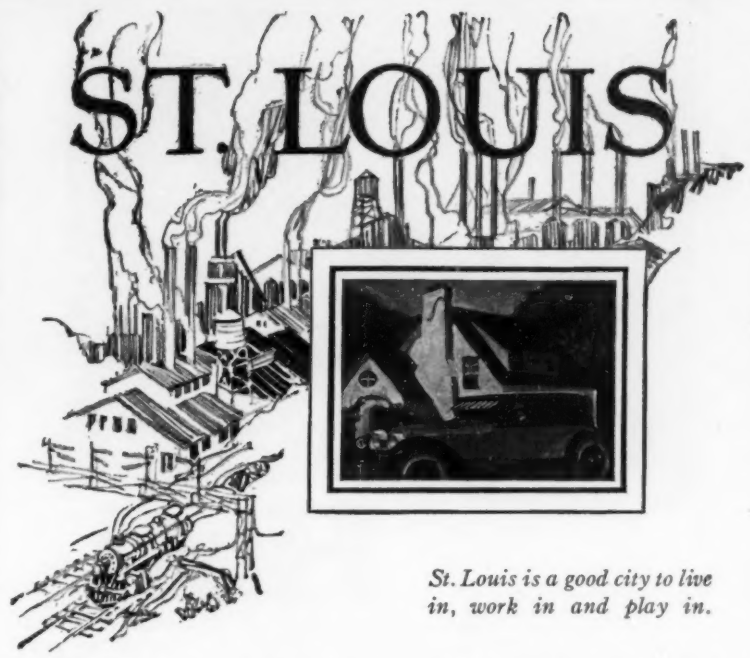
The Proposed Bridge Across the Golden Gate at San Francisco would span a gap of 6800 feet and for this purpose would have a 4000-foot center span and two shore spans of 1320 feet each. As the self-weight of the cantilever limits its spans between piers to about 1800 feet maximum, a bridge is proposed which combines the cantilever and suspension principles. The cables of the suspended span, instead of extending the full length of the center and side spans, tie into the ends of the cantilever arms at points which are so selected as to secure the economical length for both types of construction. In this case, for the single span of 4000 feet there would be needed only a suspended cable span length of 2640 feet. This design is known as the "cantilever-suspension" bridge. The span will provide a clearance of 200 feet for the passage of ships. The two main piers will be 200 feet from base to top, and superimposed on them will be steel towers 747 feet high. Their maximum width at the base will be 115 feet. The total length of the bridge proper is 6640 feet. The two main cables will be 20 inches in diameter. The cross-sectional width of the bridge is 80 feet, providing for two trolley tracks, two lines of motor cars in each direction and two 7-foot sidewalks. The center span is 2400 feet greater than that of the Manhattan Bridge and 750 feet greater than that of the proposed Hudson River Bridge. The estimates call for a total cost of about $17,000,000.—*World Ports*, 11:10, pp. 101-7.

Experiments with Rubber Paving are being made in England. Large slabs of rubber two inches thick are to be used, each slab weighing about 600 pounds so that creeping and lifting will be reduced to a minimum. The surface of the slab is corrugated, giving a safe foothold for horses. The whole is placed on a concrete foundation and the joints are cemented with tar.—*Canadian Engineer*, 45:6, p. 212.

A New Type of Caboose for freight crews has been built by an Ohio railway company in order to provide a different method of train inspection from that furnished by the conventional cupola. The new design employs side-bays and does away with all overhead structures. These side-bays are provided with tall, narrow observation windows at each end of the bay, and these permit the trainman to see along the train. The windows are hinged, allowing them to be opened and allowing the familiar smell of a hotbox to reach the trainman. As the side-bay observation windows are lower down than the cupola windows, the hotbox scent is much more likely to be observed by the trainmen. The bays are provided with seats so that the trainman may keep his train under observation much better than when the cupola caboose is used.—*Railway Age*, 75:6, pp. 237-9.

General

Bootlegging in Rubber is one of the reasons why the recent effort of the British rubber growers of India to restrict the world supply has largely failed. The British grow about 70 per cent of the rubber used in the United States. The price of rubber in 1921 and 1922, before the Stevenson restriction plan was adopted, ranged from about 13½ to 19 cents a pound, while the fixed charges of the average rubber plantation, before a pound of raw material is produced, are about 13½ cents. When the success of the plan seemed assured, in 1922, rubber boomed, the price rising to about 36 cents and automobile tires reflected this rise in cost. Some months later prices began to sag and in June of the present year had already fallen to about 25 cents. The two chief causes of this sag in the price of rubber are, first, the Dutch East Indies plantations, which are not included in the plan, produce over a quarter of the world's output; second, there was great difficulty in enforcing the restriction among the British planters themselves. There was considerable illicit trading in the permits necessary to export specific amounts



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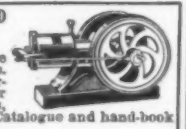

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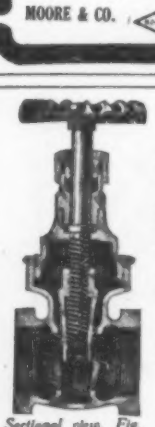

Sectional view, Fig. 370, screwed, Jenkins Standard Bronze Gate Valve.

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of rubber, as well as forging of these permits.—*The Industrial Digest*, 2:8, pp. 578-9.

A New Filtration Principle has been devised by an English scientist, Dr. Hele-Shaw, who conceived the idea of filtration through the edges of a large number of sheets of rough, impervious paper pressed tightly together, this being an entirely different conception to the usual one of filtration through the surface of a sheet. Each sheet of the waterproof paper is perforated with an identical number of holes, forming tubes when the sheets are superimposed in such a way that large and small holes are in alternate rows. Demonstrations made on muddy water, mixtures of oil and water, dyestuffs and dirty engine oil gave a complete separation.—*Chemical and Metallurgical Engineering*, 29:4, p. 148.

Deciphering Charred Papers is the subject of scientific paper issued by the Bureau of Standards, wherein is described a new method of reading records that have been subjected to such intense heat in the closed atmosphere of a fireproof safe during a fire that they have charred into carbon without being reduced to ashes. The photographic plate, it was known, is sensitive not only to light but to certain gases and vapors. In the preliminary tests a sheet of this carbonized paper was placed between two fast photographic plates and left in the dark during 14 days. When developed, a perfect copy of both the printing and the writing was obtained. Furthermore, the imprint of the writing which was on the back side of the charred paper was retained by the plate, though more faintly than the other. It was found that after some days of exposure to the air the records largely lost their power of making an impression on the plates. Results were obtained with a Seed 30 dry-plate.—*Brass World*, 19:7, p. 236.

Galvanized Iron Utensils Sometimes Cause Poisoning of those who drink liquids that have been stored in them, according to a warning issued by the Bureau of Chemistry of the United States Department of Agriculture. In a recent instance of poisoning resulting, apparently, from the presence of zinc 12 men at the Guam Naval Station had each drank a bottle of root beer and immediately began vomiting. Chemical examination of the contents of three of the bottles disclosed the presence of substantial quantities of zinc salts in each bottle. Experiments carried on by Federal chemists with quantities of lemonade, orangeade, milk, carbonated water, Washington city tap water and distilled water held over night in galvanized iron buckets proved that zinc contamination occurred in each case.

Industrial Progress

The Electric Steam Boiler, under certain conditions, is an economical means of making steam. Cheap energy must be available during at least part of the time. This energy may be surplus power purchased under a block rate but not used. With such conditions the money saved on coal may often pay for the electric boiler in a short time. A boiler of this type requires no heavy foundation or large building. It has no smokestack and no fuel storage. There is no handling or stoking. The operation is simple and requires few men. There is no smoke, dust or ashes. The boiler has a thermal capacity in the neighborhood of 97 per cent and it will generate steam at any pressure. The electric boiler generates steam by passing current directly through the water. In its simplest form the water-resistance boiler is nothing but a water rheostat. All the energy put into the boiler passes into the water.—*Industrial Engineer*, 81:8, pp. 403-5.

Using a Mass of Hot Water for the Storage of Steam in the form of heat is the basis of the steam accumulator whose practical application to steam at pressures considerably above atmospheric is a recent European development. Among the advantages gained are smaller boiler capacity and higher boiler efficiency. There is also a commercial saving at the point of utilization due to the fact that the accumulation can easily supply any surge of steam caused by putting a cold piece of apparatus suddenly on the steam line. Such apparatus may also be heated up as fast as it will take the steam, often increasing the productive capacity of the manufacturing plant. One class of application is that in which a cheap source of by-product heat is available in variable amounts and cannot be as cheaply stored by other means, as in the case of gas produced as a by-product in the manufacture of steel and coke. The accumulator is

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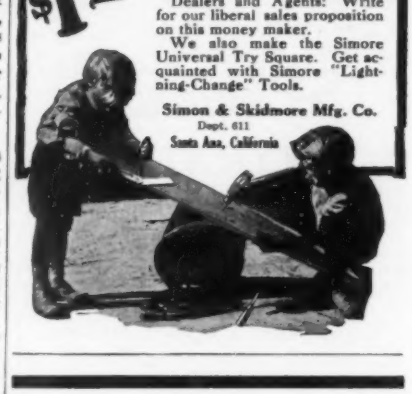

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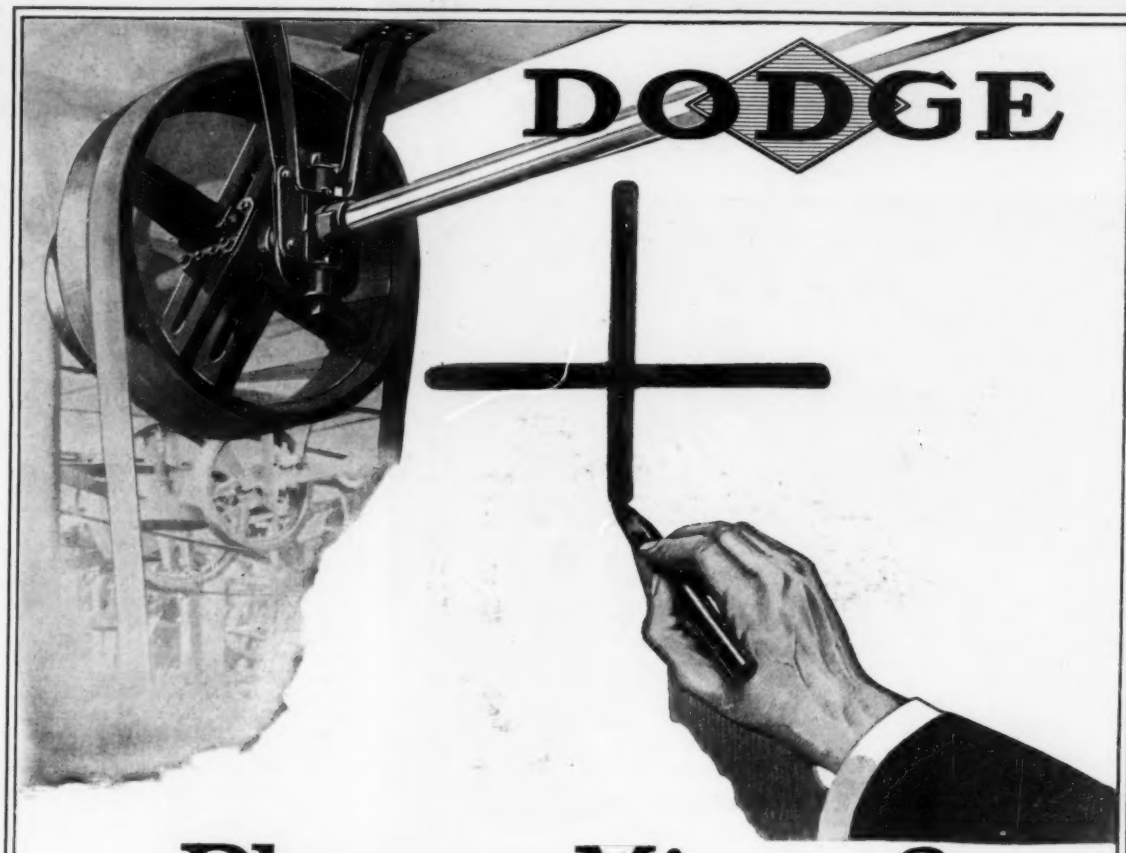
practically a "fly-wheel" for steam. It works on the principle that the amount of steam that can be stored in hot water depends upon the allowable variation in temperature, and hence in pressure. It soaks up excess steam when the pressure rises and gives it off again as it falls. The steam accumulator in Europe has found its principal application in plants where large amounts of process steam are used in widely varying amounts, notably in pulp and paper mills. It permits short peak demands of practically unlimited intensity.—*Power*, 58:9, pp. 322-6.

The Recovery of Ammonia from Hydrogen and Nitrogen with a minimum of expense and effort as compared with the higher cost of producing it in by-product coke ovens is the goal of a group of workers in a Government laboratory at Washington. An experimental compressor has been devised and put in use and is developing pressures up to 15,000 pounds per square inch. It is expected that the research work will furnish the data necessary for the installation and operation of small ammonia plants throughout the country. The direct synthetic-ammonia process for the fixation of atmospheric nitrogen is the newest of the three processes which have been brought to a commercial stage. In this process a purified mixture of nitrogen and hydrogen is subjected to a very high pressure and brought in contact with a suitable catalyst, and is maintained at about 932 degrees Fahrenheit. Under these circumstances, nitrogen and hydrogen combine chemically to form ammonia in quantities from 5 to 15 per cent of the gases present. The ammonia so formed is removed, and the uncombined gases are returned to the apparatus and again treated. Estimates indicate that a plant capable of converting 100,000 cubic feet of hydrogen into 2000 pounds of ammonia can be constructed for $50,000. In such a plant, ammonia could be produced at from six to seven cents per pound, exclusive of royalties and cost of hydrogen.—*Compressed Air Magazine*, 28:8, pp. 599-600.

Precooling of Cantaloupes in water kept slightly above the freezing temperature is a new method of avoiding loss in shipment from the Imperial Valley of California to the East. The melons are unloaded beside an endless platform carrier, which takes them in crates down an incline and through the watertank. The water in the tank is maintained at a temperature between 33 degrees and 40 degrees Fahrenheit by ammonia coils. The cantaloupes are carried slowly through the water, remaining in the tank about 90 minutes and coming out with a uniform temperature of 40 degrees Fahrenheit. They are loaded immediately into the cars and started to the city markets. Extensive tests were made to see whether water would penetrate the cantaloupes, rendering them soggy inside and probably promoting mold, but none of these difficulties has been experienced in the early experiments.—*Ice and Refrigeration*, 65:2, p. 59.

Naphthalene for Internal Combustion Engines.—Coal tar provides, when refined, two fuels for internal combustion engines, a liquid and a solid. When cooled, the bulk of the distillate is liquid, and this liquid has been extensively utilized in Europe as a fuel for Diesel engines. The solid is chiefly naphthalene. This may be centrifuged and recrystallized, giving, by a very simple process, a hydrocarbon sufficiently pure to serve as a fuel for internal combustion engines. Naphthalene has been used successfully as a substitute for gasoline in the propulsion of motor cars. Its boiling point lies within or close to the boiling point range of much of the gasoline sold in the United States. To drive such motors requires some modification of the ordinary feeding and carbureting mechanism. Most motors feed the naphthalene in liquid form, and are constantly obliged to start and run for a short time on gasoline. If all the coke-oven and coal-gas tar burned by the consumers in the United States in 1920 had been treated in a continuous still for the removal of oil and the production of pitch there would have been obtained about 48,000,000 gallons of distillate, or fuel to furnish a Diesel engine with 100,000 horsepower years.—*Gas Age-Record*, 52:4, pp. 93-7.

Sirup from Sweet Potatoes may be manufactured at a cost of about 65 cents per gallon, according to Department Bulletin 1158 of the Bureau of Chemistry of the United States Department of Agriculture. Laboratory experiments made by the Bureau indicate that about 1½ gallons of sirup to a 50-pound bushel of sweet potatoes may be



Plus or Minus?

WHICH is true in your factory? That long line of shafts and countershafts equipped with hangers, pulleys, clutches and other power transmitting units, is either delivering the maximum of generated power to your machines or robbing your production of an absolute essential to profits.

Many executives, department heads, superintendents or foremen, point with just pride to a model power plant, efficient boilers and a dependable fuel supply on the one hand, and to the latest in productive machinery on the other, give slight heed to the link between these two elements—machinery for the transmitting of power.

Dodge means power savings. Plants which have standardized on Dodge transmitting units from boiler room to finishing machines, rank on the plus side of the ledger.

Dodge stock products can be purchased from local dealers on the immediate delivery basis. Dodge engineers will submit practical recommendations on special equipment on request. Dodge service stops at neither size nor weight.

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Power

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After an extensive investigation among manufacturers in a dozen fields, the Dodge Manufacturing Corporation has determined to interest the executive in an element of his production machinery which in the majority of cases has been taken for granted.

In plant after plant, Dodge representatives have been conducted first into immaculate and ultra modern power houses and from there to the latest of producing machinery, for both of which the executive had no end of praise.

But the link between boiler room and production end was in many cases lightly passed over. The executive expressed an opinion favorable to group drive and knew its assets. But when it came to the elements of that drive he was generally vague.

"We are going to sell power transmitting machinery on the balance sheet basis," was the decision of the Dodge Manufacturing Corporation. "We are going to prove the existence of a power thief all along the line between boiler room and machines. We must show the executive that these red figures in regard to delivered power on the monthly report can be eradicated and that Dodge Transmitting Units mean power savings."

For 43 years, the Dodge Manufacturing Corporation has been an enemy of friction, which is the power thief. Dodge equipment, which includes everything for the mechanical transmitting of power has always given "plus service" in the delivery of generated power. Dodge Transmitting Machinery, where it is adopted as standard by manufacturers, is functioning day in, day out over long periods of years, and paying a profit on its cost and installation by actual savings in power.

Dodge products include everything for the mechanical transmitting of power. Extensive factories at Mishawaka, Indiana, and Oneida, New York, are equipped to meet every demand for pulleys, hangers, pillow blocks, shafting, rope and belt drives. In addition, Dodge manufactures conveyors of a distinctive and most practical type.

Extensive foundries employing skilled employes have met special engineering problems in regard to built-to-order machinery. Dodge dealers, of which there are over 500, operating under 14 factory branches, are in a position to give immediate delivery of stock products.

Dodge maintains a specialized engineering department at the service of the nation's manufacturers. This department will submit complete layouts and practical recommendations to accommodate any power situation.

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obtained. The new sirup has possibilities for use as a table sirup, for cooking and in the manufacture of candies such as taffy and caramels.

The Arc-Welding of Steel Buildings has not progressed greatly, owing to a lack of confidence in the process on the part of architects and engineers. A few structures, ranging from small sheds to 40 by 100-foot buildings have been erected without a single rivet being used, all structural members being electric welded. A 125-foot cross-channel barge and a 500-ton coastwise vessel were constructed in England and were completely arc-welded throughout. Undoubtedly there is a big future in the structural field for the arc-welding process and the building departments of our various cities will soon recognize this as a standard method of construction.—*The Welding Engineer*, 8:7, pp. 21-3.

A Novel Method of Doing Concrete Work was put into use at the Lake Placid Club in the Adirondacks last winter when it was desired to build a new clubhouse measuring 44 by 210 feet and six stories high during the winter months. In this region the temperature reaches a point as low as 50 degrees below zero. As it was impossible to complete the building in time for its use in summer unless work went on all winter the contractor built a wood shell that covered the building completely and kept it safely warm for concrete work and comfortable for labor. Not an hour was lost all winter. Better men were available at lower wages and when others were just starting spring concrete work the outer shell was torn down and the six-story building was ready for the inside finish. The shed used to enclose the job was built to extend five feet outside of the building lines in order to provide working space. It was constructed of two-by-six uprights on 32-inch centers, sheathed outside with seven-eighths inch hemlock and box spruce and lined inside with tar paper. For this immense enclosure, 150,000 board feet of lumber was used but the bulk of it was later salvaged and used in other work. The cost of this winter weather protection was about 10 per cent of the contract price. After the shed was roofed over it was heated, the coal consumption averaging 3½ tons per day. The heated air was distributed through wooden ducts and artificial lighting was provided inside the building. The temperature was kept at an average of 55 degrees. Only once did the temperature inside register below 32 degrees and the outside temperature at this time was 32 degrees below zero.—*Concrete*, 23:2, pp. 59-60.

A New Method of Butter Manufacture is now being tried in Holland and is meeting with success in delaying the deterioration of butter. The new process consists in churning in an atmosphere of pure carbon dioxide. The air is sucked out of the churn and is replaced by carbon dioxide, which fills the pores of the butter and keeps out the oxygen so long as the butter is not vigorously agitated after exposure to the air. The natural process of deterioration is accelerated by oxygen. The cost of the new process is said to be negligible in view of the advantages gained.

The Microscopical Investigation of Coal is assuming considerable importance of late. Sections of various samples are carefully prepared and studied under the microscope. It is generally recognized that two coals may have identical chemical compositions as determined by customary methods of analysis, and yet one may be applicable to a process for which the other is wholly unsuited. As a result of microscopical analysis Mr. A. L. Booth divides coals into three main classes: (1) Humic coals, composed of leaves, stems and broken down woody tissues, together with some spores. (2) Spore coals in which spores predominate. (3) Cannel coals, containing small, round, yellow bodies, which, it is suggested, are algae or microscopical animal life. For steam raining, humic coals which contain a portion of cuticle are most suitable, according to the above-named investigator. For town gas manufacture, coals containing a considerable percentage of spores should be chosen. For producer of gas work, spore coals are best. The best coking coals are those containing yellow resinic constituents. —*Gas Journal*, 163:3142, pp. 422-3.

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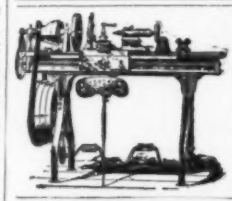

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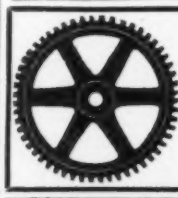

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termination of color effects than any hitherto possible. The unique feature of this machine is that it permits very nice adjustments of color relations to be made on a whirling disc while the disc is in motion. For instance, a yellow disc is placed on the machine and the blue disc is placed partly over it. The two colors blend and the proportions of each color may be shifted by the operator without stopping the discs, through the use of an ingenious system of cams and levers.—*Color Trade Journal*, 13:2, p. 56.

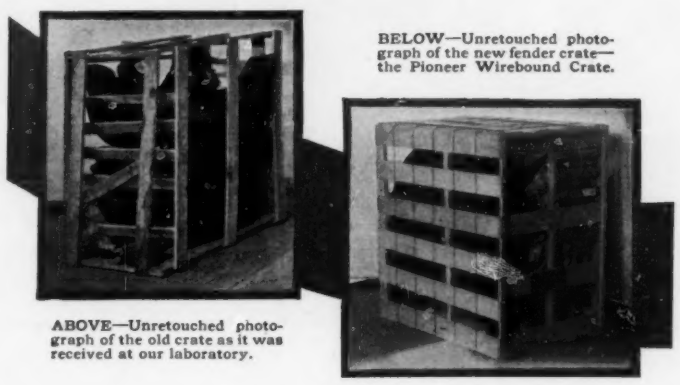
Vitreous Enameling with Electric heat has within recent years developed into a large industry. The electric furnace has demonstrated that it is without a peer when the results from its use in baking vitreous enamel are compared to fuel-fired furnaces. The control of the heat flow is so complete that uniform temperature may be applied in baking a complex shape, even though the heat flow or heat quantity varies in different parts of the charge. In case of apron bathtubs, for instance, no difficulty is met in delivering the required amount of heat at the same temperature on either the apron or reverse side of the tub, and such manipulation of heat is impossible with other than the electric furnace. In addition to the temperature control the electric furnace is possessed of a long life and low power consumption. Sulfur fumes, which are injurious to enamelware, are absent in the electric furnace, and its use secures against high percentage of rejections from this cause. The electric furnace has no noises to muffle, such as are experienced with coal and oil firing. It has been able to handle 170 heats in 10 hours, as against 130 heats with the coal-fired furnace. Heats have been completed in 50 seconds that would require 3 minutes, 40 seconds in the oil furnace.—*Journal American Ceramic Society*, 6:7, pp. 794-8.

Mechanical Engineering

A New Method of Joining Pipe Joints for artesian wells has been developed during the past few months. By use of the oxy-acetylene flame, screwed joints as heretofore used may be done away with and the well casing will become a single tube of indefinite length. Oil-well casing has been oxy-acetylene welded some years but artesian well casing is usually larger and requires a different type of joint. In the case of a well being sunk in New Jersey, nine 20-foot lengths of 18-inch steel pipe three-eighths of an inch thick were used. First, four lugs were welded on the outside of one end of each section of pipe with half the lug extending beyond the end. Properly to allow for contraction, sections of casing were prepared for welding by separating them about one-sixteenth inch with small steel wedges which were melted into the joint as the welding progressed.—*Oxy-acetylene Tips*, 2:1, pp. 10-11.

Studies on the Hot and Cold Working of Brasses made recently in Germany in a laboratory indicate that all brasses, beginning from copper and ending at 58:42, and even somewhat richer in zinc composition, can be pressed and drop forged at any temperature below the range of zinc evaporation. It was found that the application of the pressing load or of the line force of the falling hammer must be individualized for each particular brass. No attempt to work all of them in the same condition, or by men accustomed to some particular conditions, can be successful. Probably, the investigators conclude, there is a great influence due to the time factor, that is, the comparative amount of time needed successfully to produce a suitable reduction under a given load, or reversed.—*The Metal Industry*, 21:8, pp. 318-21.

A New Type of Diesel Engine has been invented and put on the market by a well-known manufacturer. This engine uses less compression and has a lower exhaust temperature than present types of Diesels. The secret of construction lies in the method of introducing the oil to the cylinder and its combustion therein. Acting under the belief that air compression of from 250 to 300 pounds gave ample heat to ignite oil in globular drops, the inventor devised a method of uniting oil and air under proper conditions for a continuously recurring engine cycle. By using a check-valve through which oil is admitted to the center of a burner composed of an inner and outer sleeve, so positioned and proportioned that they form a small combustion chamber between the sleeves, and a relatively larger combustion chamber within the inner sleeve this is accomplished. Both sleeves are open at the bottom, and the two combustion chambers are open at the bottom and communicate at



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ABOVE—Unretouched photograph of the old crate as it was received at our laboratory.

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the top through small holes in the inner sleeve. Attempts to run with lower compression and temperature have heretofore usually resulted in faulty ignition and misfiring. No such troubles are experienced with the new engine. By this advance the design of Diesel engines is so simplified that 35 to 40 per cent of the weight, and many moving parts are eliminated.—*The Marine News*, 10:3, pp. 61-2.

A Chimney Gas Scrubber of unusual and effective design has been installed in a New Hampshire power plant, and has proved entirely satisfactory for the elimination of cinders and unburned coal under the exacting conditions imposed by the manufacturers of paper. Waste gases are drawn from the boilers by induced draft fans which discharge downward into a chamber connecting the fans and chimney, causing the gases to strike and follow a curved surface over which water is continually flowing. The momentum of the dust particles causes many of them to strike this curved surface and be washed away to an open trench sewer. The connecting chamber is considerably larger in cross-sectional area than either the fan outlets or the stack. Therefore the gas velocity decreases and the dust particles drop out.—*Power Plant Engineering*, 27:16, p. 818.

The Development of the Electric Furnace for steel founders in the United States has been of extraordinary interest. The first electric furnaces to make steel for castings in America were installed in 1908, when 55 tons of such castings were produced. In 1920 this output had grown to over 170,000 tons. Expansion of this division of American industry during the last decade has been 2000 per cent. Factors that have caused this growth include the quality of the product, the availability of reasonably priced electric power, and the high price attending the scarcity of coke suitable for use in converter practice.—*Iron Trade*, 73:4, pp. 248-52.

Metallurgy

The Possible Use of Oxygen or Oxygenated Air in its application to the blast-furnace smelting of iron, the bessemer and open-hearth processes for steel, the manufacture of artificial gas and the blast-furnace smelting of ferromanganese is forecast by the Committee for the Application of Oxygen in Metallurgical and Allied Industries. The trend of development in smelting and refining is in the elimination of inert matter which does not enter into the reactions in the furnace and which simply pass through, absorbing and carrying away heat and reduced metals. In the production of one ton of pig iron three tons of nitrogen is passed through the furnace. To diminish this loss, oxygen might be substituted, or a mixture of oxygen and air. Doubtless the application of oxygen will revolutionize the art of smelting and it will probably change the whole operation and equipment, and will decrease the production costs, increase the output per furnace, better the uniformity of the product by permitting a much closer chemical control. It will make possible the use of cheaper materials, ore of lower content and coke of a higher ash, and, it is believed, will reduce the sulfur content of the iron.—*Chemical and Metallurgical Engineering*, 29:7, pp. 272-5.

Steel Ingots Replace Those of Cast Iron.—The majority of ingot molds are made of cast iron. There has, however, always been more or less interest in steel ingot molds and extensive experiments have been carried out at several plants without successful results. Fr. Schivetz, of Krompach, Germany, describes in *Stahl und Eisen* his success in replacing cast iron molds with those of steel. The molds used are the square ones for three-ton ingots. During the War the life of the molds steadily sank from 150 heats to 70 heats. Accordingly, in 1916 six steel molds were made and later the cast iron molds were entirely replaced by steel and the latter have been in use ever since. The average life of all the steel molds used so far is 235 heats, with a constantly increasing life. However, great care must be taken when pouring into steel molds as they are more easily burned than iron ones. After use the molds were placed on a rail-rack and used again only after eight to nine hours. In only a few cases was distortion of the molds noticed, and it is believed this came from improper handling. The carbon of the steel used varies from 0.35 to 0.45 per cent. The manganese is usually from 0.5 to 0.8 per cent. The phosphorous shows a maximum of 0.09 per cent. The sulfur has an 0.07 per cent maximum, and the silicon about 0.15.—*The Iron Age*, 112:7, p. 440.

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A New Method of Manufacturing Aluminum whereby clay is mixed with pyrites and heated about 500 Centigrade has been invented in Germany. On continuous calcination in a stream of chlorine gas evolved from sodium chloride, with the addition of carbon, the resulting reaction-product decomposes into aluminum chloride which is then mixed with sodium chloride to which are added potassium chloride and small quantities of strontium chloride. Transformation into metallic aluminum and chlorine gas is then effected by the usual thermo-electrical means. No cryolite is used, nor is it necessary that the clay should have a fixed proportion of silicic acid present. Moreover, in this process the chlorine gas necessary to form the aluminum chloride is not wasted.—*Canadian Mining Journal*, 44:31, p. 582. Reprinted from *Aluminum*.

Magnesium Alloys.—Metallurgists and engineers have of recent years sought to apply light metals and alloys for a great variety of purposes. More recently the magnesium alloys have received attention, because they are still lighter than those of aluminum. At first there was difficulty in producing strong enough structures with these alloys, but the French metallurgists claim to have overcome this drawback.—*The Mining Magazine*, 29:1, p. 2.

Stainless Steel comprises a series of steels containing about 11 to 14 per cent of chromium and carbon, varying to suit the mechanical properties desired, but for most purposes less than about 0.4 per cent. It often contains small amounts of nickel, up to about one per cent. This element, which is generally present accidentally, has no appreciable influence on the non-corrodibility of the steel, but may have a considerable effect on the temperature used in heat treatment operations. Broadly speaking, in order to obtain a ferrous metal which shall be incorrosible, it is necessary first to render iron insoluble in water by suitable alloying and to make the resulting alloy as homogeneous as possible by heat treatment in order to avoid galvanic effects. It is found that the presence of a sufficient amount of chromium in solution in iron reduces the solubility of the latter in water practically to zero. When chromium is added to steel, however, part of the chromium combines with the carbon present to form a carbide. In a typical stainless steel the chromium and carbon are in the proportion of about ten to one.—*Mechanical World*, 74:1908, p. 58. (Continued in Nos. 1909 and 1910.)

Hot Rolled Monel Metal has an ultimate tensile strength of over 41 tons per square inch cross-section at 32 Fahrenheit. This is greater than the ultimate tensile strength of mild steel by some 10 tons. The corresponding ultimate tensile strength of cast monel metal is under 25 tons per square inch, but at 1472 Fahrenheit the strength of the cast metal is greater than that of the hot rolled metal. Experiments made in Great Britain serve to bring out the great strength of monel metal at high temperatures. It is especially suitable for all parts controlling superheated steam. Monel metal is a natural alloy of 67 per cent nickel, 28 per cent copper and 5 per cent of other materials. It has a very high resistance to corrosive action by salt water, atmospheric conditions, alkalies and some acids. Superheated steam at 750 Fahrenheit has no appreciable effect on it.—*Marine Engineering and Naval Architecture*, 46:551, p. 303.

A New Magnetic Alloy of Very High Permeability has been discovered. It is a composition of about 78.5 per cent nickel and 21.5 per cent iron and at magnetizing fields in the neighborhood of 0.04 gauss, and with proper treatment, it has a permeability of as high as 90,000. This is about 200 times as great as the permeability of the best iron for these low magnetizing fields. This high permeability is attendant upon proper heat treatment and upon other factors, among which is freedom from elastic strain. The presence of other elements than iron or nickel, and, especially, carbon, reduces the permeability, but slight variations in heat treatment produce large changes compared with those due to small quantities of impurities. So far as discovered, other physical properties show no peculiarities at the composition which brings out the remarkable magnetic qualities of permalloy. The equilibrium diagram, electric conductivity, crystal structure, mean spacing between adjacent atom centers and density are among the physical properties which have been studied. To the engineer in electrical communication the development of permalloy is very significant. It assures a revolutionary change

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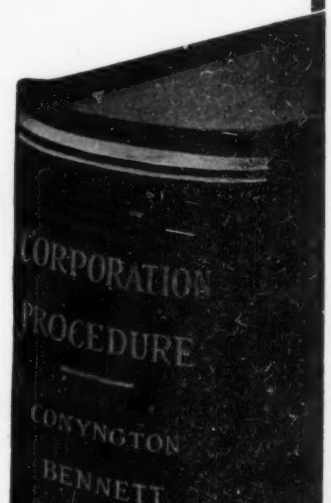

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in submarine cable construction and operation and promises equally important advances in other fields.—*Bell System Technical Journal*, 2:3, 101-11.

Contraction and Shrinkage of Non-Ferrous Alloys as related to casting practice are being investigated by the Bureau of Mines. In foundry practice patterns are usually made on the basis of a general figure for lineal contraction of a given class of alloys, such as those of aluminum, brasses or bronzes, irrespective of the alloy employed. In making light aluminum castings a general figure of 0.156 of an inch per foot is employed as the pattern allowance. But measurements made by the Bureau of Mines show that in 40 alloys the range is from about .95 to 1.8 per cent. It was found that the linear contraction af an alloy is a function of the exact chemical composition of that alloy, and relatively small amounts of impurities affect the contraction. This wide variation of contraction among the alloys of a given class indicates that it is poor practice to employ a rough figure as the contraction of a given class in general. Other things being equal, the smaller the cross-section the less the contraction for a given length; the greater the length for a given cross-section the less the contraction.—*Brass World*, 19:7, pp. 231-5.

Mining

Rubber Linings for Ball Mills are a recent development in the mining and ore-milling industry. Cylindrical and conical ball mills consist of thick steel or gray iron shells with heavy linings that may be removed when worn. In order to resist the abrasive action of the ore, these linings are chrome or manganese steel castings from two to three inches thick. These linings wear out the outer shell, owing to the constant friction between the two, aggravated by small particles of ore. The condition is so serious that the tendency is toward making cast steel shells as much as 1½ inches thickness. As a rule linings have to be replaced three times in two years. Experimental ball mills are now in operation wherein sheets of rubber are used in place of the steel linings. These rubber sheets are seven to eight feet long, sixteen inches wide and five-eighths of an inch thick and are cut to fit the inside dimensions of the mill. By their use the lining weight is reduced, effecting a saving in power of about 24 per cent. Due to moisture in the ore the inside of the shell of the mill is soon covered with rust, to which the rubber "freezes," holding it firmly in place and eliminating friction between the lining and shell, thus preserving the latter. The cost of the rubber lining is less than that of chrome steel, while its decreased thickness materially decreases the capacity of the mill. Observations have shown that the ore and the balls, instead of sliding readily over the surface, cling to the rubber, thus increasing the working zone. The rubber lining lasts about half again as long as that of steel and the relining is a shorter operation. The process has evidently passed the experimental stage and seems established. —*The India Rubber World*, 68:5, pp. 697-8.

Investigations of the Value of the Carbon Dioxide-Oxygen Mixture in the treatment of carbon monoxide asphyxia, especially with the object of finding the proportion of the mixture that is most efficient for administration and of determining the advisability of its use by first aid and mine rescue men are being carried out at the Pittsburgh experiment station of the Bureau of Mines. So far, the investigations indicate that while carbon monoxide is eliminated more rapidly from the blood by the use of the carbon dioxide-oxygen mixture than by any other method there is the possibility of instances occurring in which its use might be a disadvantage unless administered by a physician.—*Coal Mine Management*, 2:7, p. 31.

The Advantage of the New Liquid Oxygen Explosives are: low cost, less than one-third that of dynamite; the absence of danger from misfire and accidental explosion; the absence of poisonous atmosphere —in fact, it improves the air, adding oxygen; an increased output of 50 per cent per miner; the possibility of using inexpert labor for charging and tamping it; the elimination of the cost of detonators; the entire elimination of accidents through drilling into unexploded holes; and, finally, its safety of transportation.—*Iron and Coal Trades Review*, 107: 2891, p. 129.

The Trench Hat, "the old tin hat," is coming into quite extensive use as a means of head protection against small falls of rock in mines of several states. Many of the miners have been soldiers and came back with a wholesome respect for the trench hat. It was argued that if, in fun, a comrade could strike the top of the tin hat a strong blow with the butt of a rifle, without local injury to the wearer and no further inconvenience than the sudden vision of a few stars and a seemingly telescoped neck, then the accidental fall of a ten-pound piece of ore, a frequent occurrence in the mines which may seriously wound or kill the miner, would do no damage to him. One mining company was so impressed that it gave out a large number to its miners.

The Diamond Core Drill has been used for prospecting coal and mineral lands for the past fifty years, yet it is only about three years since it was "discovered" by the oil field. It has been demonstrated that the diamond drill can bore any formation which the standard or the rotary tool can bore, and do it faster and at less expense under most conditions. The cores secured by the diamond drilling process give the engineer and geologist accurate knowledge of the formations penetrated, and of the thickness, porosity and oil content of the sand when these are penetrated.—*Mine and Quarry*, 13:1, pp. 1282-8.

Railways

An Improved Type of Milk Transportation Car has recently been put into operation on a railway line running into Chicago. These cars are of the refrigerating type, with ice bunkers at either end and are equipped with two 3000-gallon seamless one-piece glass-enameled tanks. Each container is lighted by electricity and is equipped with an indicating contents gage, a recording thermometer and a propeller agitator driven by an electric motor. Inlets and outlets are made through the side of the cars so that the filling is possible without opening the doors. Soon after their arrival in the city, the auxiliary brine cooling device is put into operation and brings the temperature of the milk down to 20. The agitator is operated to restore the balance of the milk constituents before the milk is emptied to be pasteurized and bottled for delivery. Immediately after emptying, the tanks are washed with a soda solution, rinsed with cold water and sterilized with live steam. They are then sealed.—*Railway Review*, 73:2, pp. 61-5.

A New Type of Pullman Sleeping Car designed with a view to increasing the privacy of the sections when the cars are made up for the day has been constructed by the Pullman Company. In these cars, of which over thirty have been built, the permanent part of the headboard between sections has been extended from the side of the car to within about eight inches of the passageway up as far as the ceiling. In addition, the headboard is completed for night use by sliding out flush with the ends of the seat a section or panel which telescopes inside the permanent partition. — *Railway Mechanical Engineer*, 97:8, p. 572.

Locomotive Feed Water Heating has been more rapidly developed abroad than in America, due largely to the economic pressure of higher fuel costs and the more open-minded attitude of European railroad officials toward innovations. The Austrian National Railways now have seven locomotives equipped with a new type of feed water heater of the waste gas type. The design of these heaters consists principally of straight tubes between heaters located on opposite sides of the smokebox. This arrangement provides for a large tubular surface area extending across the path of the waste gases. The feed water is required to make six passes through the heater and this serves to raise it to 212 degrees Fahrenheit. Tests which were conducted with a dynamometer-car show that the saving in fuel resulting from the operation of the feed water heater ranges from 12 to 20 per cent and that the locomotive boiler efficiency can be greatly increased by an apparatus designed to raise the temperature of the feed water by reclaiming heat from the waste gases of combustion. Moreover, the operation of the locomotive is further improved by reducing the temperature and hence the volume of the gases exhausted from the stack.—*Railway Review*, 73:3, pp. 96-102.

The Lift or Poppet Valve for Locomotives has not been looked upon with favor by mechanical officials of American railways, but their use is growing rapidly abroad. It is generally recognized that both slide and piston valves actuated by the Walschaerts or similar valve motion do not give as quick

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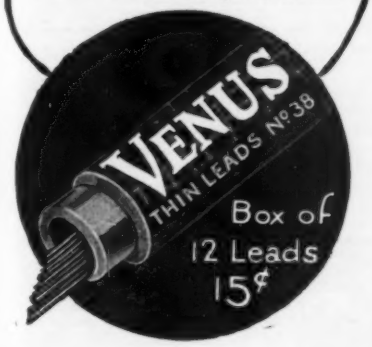

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an opening or closure as might be desired. Moreover, the area of this opening is too restricted. Consequently the valve ports tend to throttle the steam to such an extent that full boiler pressure cannot be realized in the cylinders. European designers have, therefore, been impressed with the possibility of improving steam distribution in the cylinder by means of the lift type of valve. The latest and most practical piston valve mechanism designed to improve steam distribution in the locomotive cylinder is found in the Pilliod sleeve valve which has recently been fitted for the first time to a locomotive of modern proportions. It was found that this type of valve enabled a locomotive to perform the same amount of work with less steam, because it is used more expansively than in the case of the ordinary type of piston or slide valve. This valve mechanism, consisting of an ordinary piston valve and two sleeves, enables the locomotive to approximate the conditions found in the best Corliss engine practice and it is reasonable to look for a really fundamental improvement in locomotive operation through its use.—*Railway Review*, 72:24, pp. 988-92, and 73:7, pp. 225-33.

Shipping

Thirteen Years Afloat without Drydocking is the record of the British steel training ship "Exmouth" which was recently docked and graved at Tilbury. Her comparative immunity from rust is attributed to the fact that when she was first launched no paint had been applied to her hull and she lay in the water for some weeks while being fitted up. During this time the sea water had an opportunity to destroy the millscale on her plates, which is the secret of the record period during which she did not have to be graved. After being afloat a few weeks she was drydocked and her bottom was cleaned with wire brushes and fresh water and was painted. It is considered that the formation of the millscale during the process of manufacture of steel plates is the cause of serious corrosion. This millscale is formed, to a large extent, by the sand which is thrown on the plates during the process of rolling in order to enable the rolls to take a proper grip. Six months after going to sea, owing to vibration and to expansion and contraction, about half of this millscale has fallen off, taking the paint with it. The vessel is then placed in drydock, superficially scraped and repainted. In many places, however, rust cones have formed and the result is that paint is applied over rust, and the rust spreads under the paint. It is now being advocated that ships be launched without paint, so that the millscale can be done away with for good and all.—*Shipbuilding and Shipping Record*, 22:5, pp. 132-3.

Miscellaneous

Be Careful of Asking for Telegrams Collect.—A mayor of a Pacific Coast city recently dedicated a radio broadcasting station and he was so pleased with the sensation that he asked everybody to send him telegrams collect so he could see how his voice carried. He began to find out by midnight when he had received replies—collect—from every state in the union as well as from Honolulu. He received a wireless from a ship 1000 miles out at sea. His voice upset his bank account about $3000.

The Post Office Department Locksmiths.—The postal laws and regulations forbid postmasters or other postal employes to repair locks, themselves, and as a result 18,000 were sent during the year to the mail equipment shops in Washington to be repaired. The average cost of repairing each lock amounted to about six and a half dollars. Figures just compiled show that the Post Office Department manufactured 350,152 locks during 1922 at a cost of $79,000. In 1921 the number of locks turned out for the use of the postal system was 136,938, the cost being $47,500. According to these figures, 213,214 more locks were manufactured in 1922 than in 1921.

Pencil Pigments in Writing.—In a recent issue of *Discovery* Mr. C. Ainsworth Mitchell discusses the question of the identification of pencil pigments in writing. He shows that the microscopical appearance of lead and its alloys is quite distinct from that of graphite, the lines showing a disconnected series of patches irregularly distributed, uniformly and brilliantly lit up, and each patch is marked with regular vertical striations. Writing in different pencil pigments may sometimes be differentiated by chemical tests. For example, the graphite and clay used for the pigment frequently contain very varying amounts of iron or of chlorides, and

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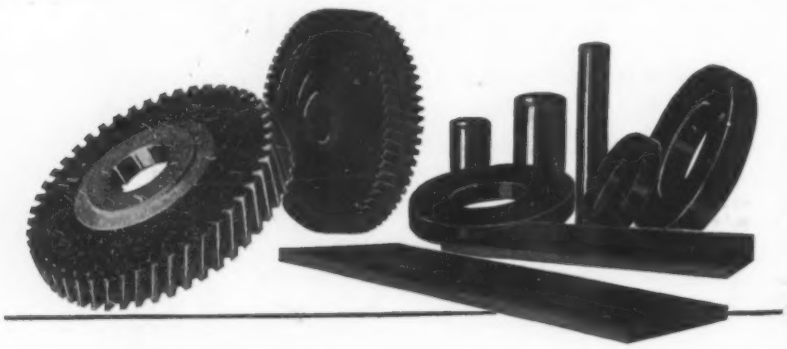

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the markings with them show reactions of different intensities when tested with the respective reagents. Titanium is also a common constituent of natural graphites, but seldom sufficient to give a distinct reaction in the markings on paper. In that case, however, a color test alone was sufficient to distinguish the marks made with that pencil as compared with others examined.

Freak Laurels.—The United States is generally credited with the bulk of freak enterprises and ideas, but at last we seem to be likely to be relieved of some of this notice. Paris has a paper devoted to the interests of servants. It is appropriately called *L'Escalier de Service* or "Back Stairs" periodical. It is filled with the doings of servants and prints stories about butlers, cooks, parlormaids, etc. Its subscription list was 6000 when the first number was issued. Janitors in Paris are a powerful class as is witnessed by their union and their "rules" for tenants. They also have a "house organ," but it is of more limited appeal than the one cited.

Rubber Pavement.—An experimental stretch of roadway in Borough High Street, Southwark, has been covered with a new type of rubber block, the upper half inch consisting of resilient rubber and the remainder of hard rubber. The two grades of rubber are vulcanized together, forming a homogeneous block.

Lost, a Railroad!—A supplementary railroad built during the war, to supply troops near Amiens with food and ammunition, has disappeared, having been stolen piecemeal. It is thought that alien workers in the devastated area appropriated the property and sold it.

Sixty-Mile Ski-Slide Opened. — The longest ski-slide in the world, extending over sixty miles, has been opened in Sweden. The course is laid out on an old road winding through the hills of a beautiful forest.

Europe's Coffee Consumption. — Europe's coffee cups were filled with the infusion of 1,189,048,000 pounds of coffee in 1922.

Newspaper Baffles Newsboys. — The newspaper with the longest name in the world, at least in the English language, is the *Farnham, Haslemere and Hindhead Herald, Alton Mail, Bordon and Longmoor Journal, Liphook and Liss News and North Sussex Advertiser.* It is a weekly publication and can be taken home for two cents.

Keep Your Windshield Clear.—The following formula has been found useful in keeping the windshield clear in wet weather: One dram of sodium chloride (common salt), one ounce of water and two ounces of glycerine. Place a little of this solution on a piece of gauze and wipe over the glass in a thin layer, using a downward stroke.

A Hotel for Dogs.—Hotel proprietors are not very keen on entertaining the canine companions of their guests, and constant squabbles result when visitors attempt to smuggle in and feed their pets. Accordingly, Los Angeles is to be favored with a hotel for dogs which will cater to the "tourist trade" by offering rooms "with" or "without" bath. Probably most of the dogs, if they could speak, would engage accommodations "without" bath. The dogs will be well taken care of while their mistresses are shopping or posing under the studio lights.

Mercury in Japan.—A rich vein of mercury ore believed to extend for more than seven miles on the surface and to vary in width from two to six feet, has been discovered near the village of Kita Uonome in the upper Goto Archipelago of Japan, the Department of Commerce hears. Assays show the ore to be very rich, containing 18 per cent of mercury, and preliminary excavations indicate that the vein increases in thickness the deeper it is followed. It should make Japan independent of the rest of the world for its supply of mercury.

Ski-Planing.—This is a new sport which has been brought out by Lawrence Sperry, the clever son of Elmer Sperry. The ski-plane is a winter version of the aquaplane, except that one uses an airplane and a pair of skis instead of a motor boat and water sled. Sperry succeeded in holding his airplane as low as five feet above the earth as he sped along the course, but was forced to rise higher when approaching a grove. The skiers would release their hold on the ropes tied to the wings and tail skid of the plane as they approached the trees. To demonstrate the unusual qualities of the small plane Sperry went down the side of a forty-foot embankment, almost perpendicular, without turning over. The machine was outfitted with skids during the demonstration.

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Artificial Wood.—A Norwegian scientist has succeeded in making a new kind of artificial wood. A mixture of sawdust with chalk and chemicals is used for this purpose. The wood contains about 50 per cent sawdust. The mixture is subjected to high pressure, and a product is thus obtained which possesses all the qualities of genuine timber. The specific gravity of the wood is the same as that of real wood; its hardness is like that of the oak. It can be planed, sawed, bored, nailed, painted, stained or polished and subjected to every process of carpentry or manufacture for which real wood is used. It will not deteriorate in water, and on account of the chemicals that it contains it is impervious to rot and burns only at a temperature very much higher than that at which real timber ignites.

New Paper-Making Materials. — Various new materials have been tested by the Imperial Institute regarding their availability as paper-making stock, and these tests have been reported in the Bulletin of the Imperial Institute, volume XX, number 3. There are mentioned talipot palm-leaf stalks, betel-nut husks and elephant grass. The palm-leaf stalks have been found to be a promising paper-making stock, as they furnish a fairly good yield of pulp. The unbleached pulp yields a strong brown wrapping paper and fairly white paper can be made, possessing good strength, but the pulp bleaches with difficulty, requiring a large amount of bleaching powder. The tests made with betel-nut husks showed that this material was not very suitable for paper-making. It can only be employed in conjunction with long fiber materials for producing low grade brown papers or boards. Good tests were obtained with the elephant grass.

Wood for Lead Pencils.—Florida cedar wood is generally used in the manufacture of lead pencils. But there are other woods which can be used for this purpose as well, provided they are given prior treatment to soften them up properly. The Badische Anilin und Soda Fabrik has been granted a patent (See British Patent No. 195,497) on a process for softening alder, lime and other woods to render them suitable as substitutes for Florida cedar wood in pencil manufacture. The wood is treated under high pressure, for example about 100 to 1,500 pounds per square inch with aqueous solutions of soaps (other than resin soaps) or soap-like compounds, such as fatty acid sulfonates, with or without the addition of dissolved or emulsified waxes or fatty material, and dyestuffs, such as cedar brown, GR. The treatment is effected at or slightly above room temperature.

Potash Discovery.—The London *Times* reports that extensive potash deposits have been discovered at Klein Kuhren, on the Elb near Dannenburg in Hanover, during test borings for petroleum. Below the potash deposits oil has been found as well, but not in appreciable quantities.

Sulfuric Acid and Caustic Soda from Sodium Sulfate.—In the Journal of the *Society of Chemical Industry*, June 8, 1923, pages 251T to 252T, there is given a description of an investigation made to determine the conditions under which caustic soda and sulfuric acid could be produced from sodium sulfate. The process developed is electro-chemical in nature. A 40 per cent aqueous solution of sodium sulfate is used in the process.

Sulfate of Lead in the Electric Furnace.—Lead sulfate is made directly from finely divided sulfide ore. The ore is fed in a regulated stream between the arcs of an electric furnace, the electrodes of which are arranged horizontally in two or more pairs. The high temperature of the arc converts the material into vapor form. The vapors pass up a shaft and meet a supply of air from a conduit in the furnace which is situated a few feet above the arcs. The hot suspended particles in the vapor are converted into lead sulfate. This is washed from the flues by steam jets or water sprays into settling vats. Acid may be added thereto in the proper quantities in order to convert the remaining oxides and sulfate of lead into lead sulfate. For further details the reader is referred to British Patent No. 189,160.

New Indigo Dyestuffs.—The dyestuffs of the dimethyl indigo series have not been used very considerably up to the present time, due to the fact that they produce dull colors on cotton and wool. However a new process has been developed of changing the chemical properties of these dyestuffs by the introduction of halogen groups, resulting in a product which is a dye both for cotton and wool. The dyestuffs give bluish shades, which are fast to light and washing. The woolen cloth is dyed in the darkest shades in one dip, the tints being comparable in sharpness with those of the finest acid dyes. The shades produced on cotton cloth are in many ways superior to those obtained with other dyestuffs of the indigo series. The reader is referred to United States Patent No. 1,412,038 and the Color Trade Journal for further information on this subject.

Casein for Making Coated Paper.—In an article appearing in the French paper journal, *Papeterie*, it is stated that though casein gives fairly good results, it is not so satisfactory as gelatine, as it is more prone to putrefaction, and must be prepared within a relatively short time before use, less than forty-eight hours in the summer time. The addition of formaldehyde as a preservative has the disadvantage of thickening it and prevents it from working properly. It has been found that borax and ammonia, 10 per cent of either, are the most satisfactory solvents. For many purposes borax is preferred to ammonia. But when casein is to be mixed with substances having an acid reaction, it is well to add a slight excess of ammonia to prevent the casein from thickening. Foaming in the sizing tub can very readily be prevented by the addition of a little milk or oil of turpentine to the coating solution, or by allowing amyl acetate to drop slowly on the surface of the solution.

New Drying Process.—A new drying process has been developed in Germany, which consists in spraying the liquid into the drying chamber by means of a horizontal rotating disk. This makes it possible to handle many substances which could not be processed by spraying, because of clogging of the spray nozzle. The speed of the disk can be made so great that substances which cannot be dried in any other manner can be dried in this apparatus. The dryer has been used in the manufacture of powdered milk and is claimed to give a very excellent product. It has been used in the drying of colloidal solutions, extracts of drugs, active principles of glands, dyewood extracts, food solutions of all sorts, glue, gelatine, etc. For further details, see *Zeitschrift fuer angewandte Chemie*, 35 pages 535-5.

Metal Linings by the Spray Process.—The spraying of molten metal on to surfaces in order to produce metallic coverings is no new process, and yet it has not been completely successful in the past. The covering obtained heretofore possessed a somewhat porous texture, an undesirable quality in resistant linings for chemical apparatus. Now, however, it is claimed by the Metallisator A. G. that thoroughly satisfactory tin, lead, aluminum and copper linings can be produced on iron by subjecting the sprayed metal coat to a finishing process, which may be either mechanical or chemical or both. The lining may be rendered more coherent by hammering. Or the pores may be filled up with some chemically resistant material, for example, in the case of a lead lining, with lead sulfate obtained by treating the lining with sulfuric acid. The great advantage of these sprayed linings over the usual laid-on ones lies in their close contact with the substratum, an important factor in apparatus with walls through which heat is to be transferred.—*Jour. Soc. Chem. Ind.*, 1923, 327-8.

New Benzol Process.—According to the *Oil, Paint and Drug Reporter*, the Piron-

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Caracristi process of low temperature distillation, which has been installed in the plant of the Ford Motor Co., promises a higher yield of benzol than has hitherto been possible. This process will extract from one ton of coal ten gallons of benzol, twenty gallons of tar, ammonia equivalent to twenty pounds of ammonium sulfate and three gallons of creosote oil, besides coke and gas.

Tensile Strength of Cotton Yarn.—Unbleached and unsized warp yarn, treated with various water-proofing materials, was tested to determine its tensile strength and then exposed to the weather. At the end of one year the treated yarn was stronger than the untreated yarn similarly exposed but weaker than the treated yarn before being exposed. Yarn subjected to three treatments containing asphalt showed no material loss in tensile strength after being exposed. Raw drying oils caused more deterioration than the same oils previously boiled with metallic driers. In most cases semi-drying and non-drying oils caused as much deterioration as raw drying oils. The addition of burnt umber to a drying oil-treatment had a decided preservatible effect. Published in *Jour. Ind. Eng. Chem.*, 15, 236.

Prevention of Food Poisoning.—The following practical summary of the precautions necessary to avoid food poisoning appeared in an article published in the *American Food Jour.* 17, page 15. Food to be eaten raw should be fresh, clean, sound and free from stale odors, from slimy rotting areas, from discoloration and mold. It should be carefully washed in an abundance of clean water. Sound food freshly cooked does not cause food poisoning. Moist or soft cooked food if held for more than a few hours should be kept in a good refrigerator. If such refrigeration is impossible the food should be recooked before serving even if it does not shown any signs of spoiling. The frequency of enteric outbreaks and of botulism clearly points to a very general failure to appreciate the dangers of basterially contaminated foods. Detailed suggestions for the inspection of canned foods are offered in connection with the campaign against botulism.

More Gasoline from Petroleum.—More and more gasoline is being produced from petroleum due to the installation of cracking processes, which break down the higher boiling point fractions into hydrocarbons which are generally found in that fraction known as gasoline. A new German process, recently developed by a chemist of the Badische Anilin und Soda Fabrik, is said to yield 75 per cent gasoline from petroleum. It is known as the Mutol process and is claimed to be superior in many ways to the various cracking processes now in use. It is said that 5 to 10 ton units can be managed by one man.—*Oil, Paint and Drug Reporter,* June 4, 1923.

New Varnish Gum from Mexico.—The Department of Commerce reports the fact that a resin can be obtained from the cuapinole tree of tropical Mexico. This resin can be used in the manufacture of the finest varnishes. One of the features of the new resin is that it is not soluble in alcohol or gasoline, as the case with the majority of similar products, and can only be refined or dissolved by a process of melting. It is pointed out that Mexico has been the producer of numerous resins suitable for making plain and fine varnishes, and adds that the cuapinole resin is believed superior to any of them.

New Fuel for Motors.—A new fuel for motor engines and internal combustion engines of various kinds has been announced under the name of ethyl gas. In the investigation, which lasted several years, to discover the ideal fuel various features of the combustion of a fuel in the motor cylinder were studied. One of the things that were studied was the knock in the engine, which was generally ascribed to ignition on the wrong side of dead center, or that red hot carbon points ignited the fuel charge before the spark could, or that there was auto-ignition. These theories were disproved, and it was found that what caused the noise was a high pressure, high velocity gas wave striking the side of the combustion chamber or the top of the piston. This high pressure wave has been known to cause considerable damage, sometimes breaking spark plugs and even wrecking an engine. The new fuel will be brought out on the market within a short time.—*Oil, Paint and Drug Reporter,* June 11, 1923.

Paper from Flax Straw.—Immense quantities of flax straw are produced each year in the Canadian prairie provinces, and attempts have been made during past years to find a use for this product which ordinarily goes to waste. It is estimated that there are each year over a million tons of this straw available after the seed has been recovered by threshing. The straw has been burnt each year in order to clean the land for future farming operations. The research work that has been carried out to find a new use for this material was conducted under the auspices of the Canadian Pacific Railway and the Honorary Council for Scientific and Industrial Research.

The straw was known to have a certain value for its fiber, being in this respect similar though of inferior grade to the straw cultivated for the production of fiber flax. The threshing process, however, had the effect of destroying the fiber value of the linseed flax straw, even for the production of the commercial tow, owing to the way in which the straw is broken up in the threshing. This suggested the possible use of the straw for the manufacture of paper pulp. The scientific details for making a high grade writing paper from this raw material were worked out to perfection, but unfortunately the cost of the process was too high to make it possible to use the same on a commercial scale. Accordingly, investigations were carried out to determine the feasibility of manufacturing cheap newsprint from this stock. Definite results have not yet been published.

A recent improvement in the machinery used to extract the seeds renders it possible to perform this operation in such a manner that the fiber value of the straw is not destroyed. Hence there is now possible the use of the fiber in manufacturing the lower grades of linen cloth. A process has also been worked out for using the flax straw in the manufacture of a heat insulating material. The resulting product is an efficient non-conductor of heat and cold, and is being used with success as linings between walls and under roofs. Flax straw can also be used to good advantage in the manufacture of tow for upholstering.

Carbon Black by Electrical Cracking.—There is a great deal of current legislation in the various states against the present method of producing carbon black by the incomplete combustion of natural gas. This coupled with the increasing demand for natural gas for other purposes indicates that the supply of carbon black will be gradually reduced and that new methods will have to be found for its manufacture, so as to utilize the carbon that is in the natural gas to better advantage. The Bureau of Mines has been making extensive investigations on this important subject, which are reported in Serial No. 2417.

It was observed in these investigations, when discharging electricity through the gas under certain definite conditions, that the natural gas could be decomposed and that carbon black could be produced. Various types of electric discharges have been studied to determine the underlying factors and their possible effect on the yield of carbon black.

Present commercial plants using natural gas for the manufacture of carbon black, recover from 0.8 to 1.5 pounds of carbon black per thousand feet of gas consumed. This is less than 5 per cent of the carbon in the gas. In the present methods the gas is heated to incandescence by burning it as a luminous flame, and therefore a considerable quantity of the gas is consumed as a source of heat. A greater yield of carbon per thousand cubic feet of gas can be expected when the heat is supplied from some external source or by using the energy that is inherent to the gas in a more effective manner to bring about decomposition of the same.

Chemicals from Granite.—Granite consists principally of the mineral feldspar, which is known to have a high content of potash, alumina and silica. A new process for recovering these constituents from granites is described in the *Raw Materials Review.* The process is known as the Brown process and is of special interest in that it permits the recovery of all three of the ingredients in a marketable form. The process consists in the application of acid gases to finely ground feldspar, in a rotary kiln, at low temperatures. The disintegration is continuous and complete, and the finished products are obtained by leaching and crystallization.

By means of the Brown process the 17 to 20 per cent of alumina contained in potash-feldspar can be converted either into sulfate of alumina or partly into the combined sulfates of potash and aluminum, or

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Basic Slag As a Fertilizer.—The chief compounds in basic slag are apatite, a mixture of calcium fluoride and tricalcium phosphate, dicalcium silicate, aluminates, ferrites, and oxides of ferrous iron and manganese in the free state. Low grade basic slags, obtained in the open hearth process of steel manufacture, were tested to determine their fitness for fertilizing purposes. It was found that this type of basic slag possesses a distinct value as a fertilizer. It was also concluded from the fertilizing experiments that the finer the sub-division of the slag, the better fertilizer it made.—*Jour. Soc. Chem. Ind.*

Cream of Milk Sugar from Larchwood.—Montana larch is being treated for the production of cream of milk sugar. Cream of milk sugar or mucic acid is a product of the sugar galactose. It is extracted in its complex form, then hydrolyzed and oxidized to the acid derivative. The product is pure white and crystalline. It contains no impurities such as metallic salts. It has a taste similar to citric acid or tartaric acid and does not deteriorate on standing. It is employed in the manufacture of foodstuffs, soft drinks, jellies, jams, ice creams, candy, medicine, etc. It is also used in the mordanting of cloth preparatory to dyeing and printing. It is also used to a large extent in the baking of bread, either for straight baking acid or for manufacturing self-raising flour or baking powder. It has approximately twice the working strength of cream of tartar. Oxalic acid is recovered as a by-product in this process.—*Raw Materials Review.*

Removing Sulfur from Gas.—According to Swedish Patent No. 51,536, this is done by mixing the gas with a suitable amount of acid in one form or another and then introducing the mixture into a chamber or a series of pipes. In this apparatus the mixture is heated to a temperature high enough to decompose the sulfuretted hydrogen, present in the gas, to sulfur dioxide and free sulfur. Then the gas is passed through another apparatus in which a reducing action takes place whereby the sulfur dioxide is decomposed to free sulfur.

Churning Temperature.—Many floating dairy thermometers indicate 62 degrees F. as churning temperatures. In the old days, when whole milk was churned, this may not have been far out, but separated or skimmed cream seldom calls for so high a mark. Requirements vary according to several factors, among them, as an English expert points out, the thickness of the cream; its degree of ripeness, the temperature of the air, the breed of the cow, and even feeding and period of lactation. Authorities in dairying state that the range is from 45 to 62 degrees F., the higher point being used only in very cold weather. Manufacturers who indicate the 62-degree temperature on their thermometers do not seem to know why they do so, except that it has been the custom for many years.

The Tanning of Fish Skins.—A Norwegian has patented a process whereby fish skins are salted and limed in a dilute solution softened with soda, the strength being progressively increased by additions of milk of lime; after rinsing, and sometimes puering, they are submitted to the action of a vegetable or chemical tanning agent only slightly acid or neutralized. For chrome tanning the skins are puered, treated in a solution of sodium chloride to which hydrochloride acid is added in increasing quantities, soaked in soft water, and tanned in pure chromate in gradually increasing quantities. After washing they are treated with sodium thiosulfate or soda, and freed from acid by means of tepid water and chalk.

Beware of Fake "Booze" Powders.—In our mail frequently come advertisements, generally from the foreign wine-growing districts, offering "dehydrated" alcoholic beverages in powdered form, usually for "one dollar only," in *American currency.* This is significant, as the Post Office authorities are constantly issuing fraud orders and returning money orders. If these powders really contained alcohol they would be seized, and as they do not have the latent possibilities of cheer, they come under the mail-fraud statutes.

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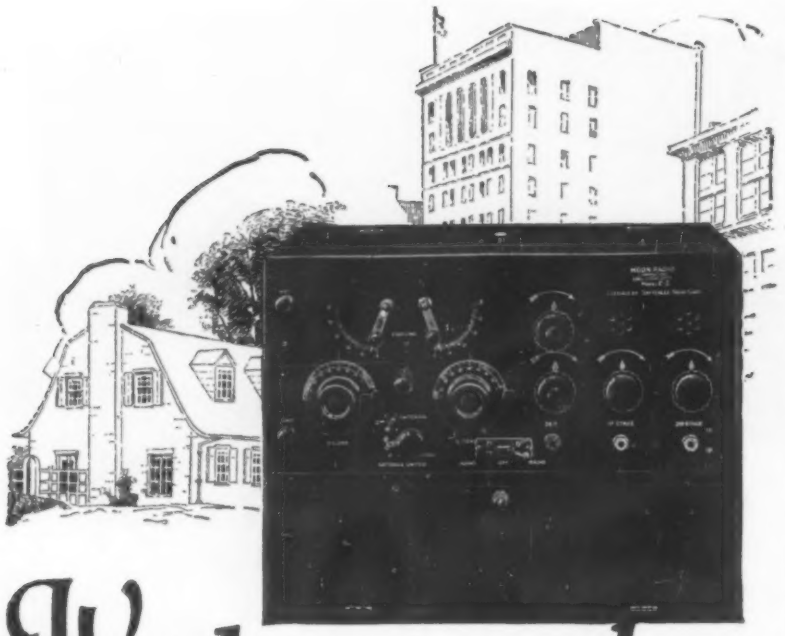

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Radio Notes

Wired Wireless Communication. — A publication giving an introduction to wired wireless or line radio communication has recently been prepared under the direction of the chief signal officer with the cooperation of the Bureau of Standards. This pamphlet gives an explanation of how messages are carried to distant points by radio-frequency currents directed over wires such as ordinary telephone lines or power lines. The fundamental principles of radio and its relations to line radio telegraphy and telephony are also discussed. This pamphlet is "Introduction to Line Radio Communication," Signal Corps Radio Communication Pamphlet No. 41, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Radio Dramas have been broadcasted by the WGY station of the General Electric Company at Schenectady for nearly a year. During that period the little group of WGY Players has had the largest audiences ever before accorded dramatic offerings. There are at least 2,000,000 radio sets in the country, and of that number 1,500,000 are almost nightly within range of WGY. From the very first the radio drama has been a success. Mr. Edward H. Smith, formerly an actor and director on the professional stage, has been handling this feature of the WGY programs. Mr. Smith and his players have pioneered in the art of the radio drama; they have had to develop a new technique. It has been found necessary to make occasional changes in play manuscripts, especially where a climax depended upon sight for its appreciation. The entrance to or departure from a room by one of the characters has to be indicated by sound, as a closing door. A bell helps somewhat in announcing a newcomer to the invisible stage. Various sound devices have been created to produce atmosphere. A telegraph key and an imitation of an engine whistle have helped in a railway station scene. Storms have been stimulated by devices similar to those used on the stage.

The Acoustics of Loud Speakers are discussed, among other things, by Mr. Nyman in the *Journal* of the American Institute of Electrical Engineers. "Speech and music are both modified considerably, depending upon the length and shape of the horn, also on the volume of the sound," states this authority. "A horn longer than one-quarter wave length of the lowest pitch available gives the best reproduction. However, in practice the length of the horn seldom exceeds three feet, approximately one-fourth of the wave length of 90 cycles, the fundamental of the horn. If the horn is shorter than one foot (270 cycles fundamental) the bass and baritone voices are likely to be distorted, since their fundamental, which is below 270 cycles, would be reduced. It has been found that a loud-speaker with a magnetic balance and a horn about two feet long is capable of very good reproduction of even very low frequencies. Careful study has been made of materials to be used in diaphragm and in the horns in so far as it affects the quality of reproduction. Aluminum or micarta diaphragms apparently give the best results, while a wood horn or horn made of some 'dead' material like hard rubber is least likely to introduce a strange quality."

Our Japanese Radio Link.—The radio telegraph circuit between the United States and Japan is operated continuously, carrying a large portion of the trans-Pacific telegraph traffic. When the recent disastrous earthquake devastated Tokio and Yokohama the radio service was not interrupted. The first news of the disaster came to the United States over this radio circuit, and for several days thereafter the most complete dispatches describing the extent of the losses and damage came via the Radio Corporation service. There are several Japanese stations working with America. First, there is the Iwaki radio system, owned and operated by the Japanese Government, comprising a transmitting station at Haranomachi and a receiving station at Tomioka. The general location of these stations was determined by the comparative freedom of the district from seismic disturbances. The transmitting aerial at Haranomachi is of the umbrella type, supported by a self-supporting central tower and an outer ring of 18 spliced, guyed wooden masts at a radius of 1300 feet. The central tower is a reinforced concrete tube 660 feet high, 57 feet in outside diameter at the base and 14 feet outside diameter at the top. The wooden masts in the outer ring are 250 feet high and consist of three sections.

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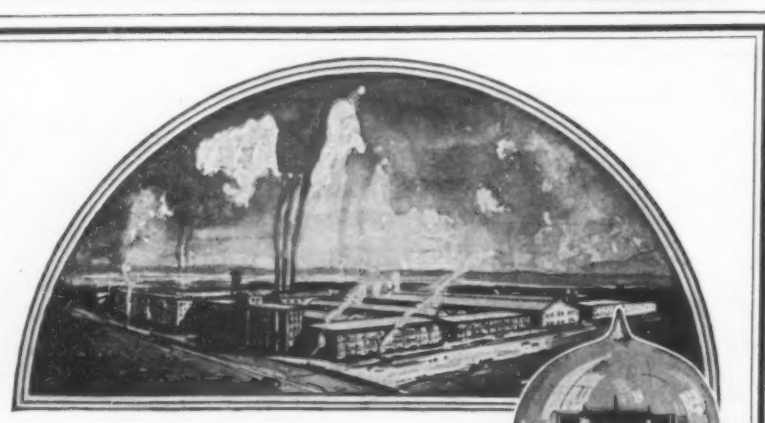

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Radio Notes

British Empire Wireless Plans.—Recent statements of the British Postmaster General indicate that a solution has been found to the problems connected with the establishment of the British Empire wireless chain. Not all points connected with the issuance of wireless licenses have been disposed of, but there is every indication that the Government has adopted a policy which will permit private radio companies to establish high-power stations both in the United Kingdom and in the colonies. At the same time the post office will proceed with its own plans for a high-power station in England. The new post office station will be located near Rugby, a site with an area of 800 acres.

High-Power Radio Station for Belgrade.—Work has been started on a new 100-kilowatt radio station at Rakovica, about four kilometers from the Serbian capital, and on a receiving station at Laudon Trench, a suburb of that city. The station is being built by the French Wireless Telegraph Company and the total expense is estimated at about $402,800. On its completion the entire installation will be taken over by the State. The operating personnel will become employees of the Department of Posts and Telegraphs, the company maintaining one engineer as a technical adviser. This particular station will be the first high-power radio installation in the Balkans, and because of the greatly increased facilities which it will afford for the dissemination of news and the rapid dispatch of information, it should soon become well known internationally.

Increasing Interference from Spark Stations is being noted by radiophone listeners, especially in the New York area. Evening after evening the spark stations break into the excellent musical programs of the broadcasters and mess things up for the listeners. During the most exciting moments of the short but thrilling Dempsey-Firpo bout, the spark stations broke in with the most aggravating racket. The writer of these lines has listened to spark stations sending the test letter, "V," minute after minute during the height of the evening broadcasting entertainment. Of course, the stock excuse on the part of spark operators is that broadcasters are either using inefficient receiving apparatus, which cannot be tuned sharply enough to eliminate undesired waves, or that the broadcasters lack the necessary skill to tune properly—or most likely both. To which we hasten to reply that even with the sharpest kind of tuners, such as the Reinartz circuit, we have time and again been unable to eliminate the intense interference from spark stations. Obviously, the radio inspectors have a job ahead of them. The majority rules, does it not?

New Ideas for Grounds.—Three methods have been introduced during recent years with a view to minimizing ground losses, namely, the multiple antenna of Alexanderson, which is employed at Radio Central; the powerful multiple transmitter station of the Radio Corporation of America; the ground screen installed at several of the Marconi stations, and the multiple ground system in use at Sainte-Assise and being installed at Nauen. The first-named is applicable to very long aerials at a medium height, and especially to those of the T or inverted L type. It really reduces it to a number of smaller aerials connected in parallel and the paths of the ground currents are greatly reduced. The ground system of each one of the multiple aerials has still to be properly designed and may involve either of the other methods. The ground screen is a development of the insulated counterpoise, the wires being so spaced and arranged that they practically screen the ground from the electric field of the aerial. The introduction of the ground screen has reduced the ground resistance of the stations where it has been installed to a fraction of the previous value, with a corresponding increase in the efficiency. The multiple ground system, on the other hand, consists in distributing under the aerial a large number of ground plates or pins, the currents from which are brought back to the transmitter station by means of overhead wires. The French engineers at Sainte-Assise have fitted up both types, so as to compare the relative merits of the ground screen and the multiple ground system. It appears that they have decided on the latter, the reasons being given that the ground screen is expensive and that the large number of wires with their supports and insulators make it difficult to carry out work on the aerial. They consider that equally good results can be obtained by the multiple ground system.

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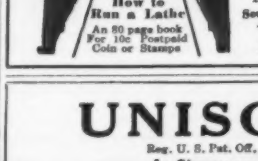

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The Drama of Disputed Documents

(*Continued from page 303*)

rapidly building up his credits with jobbers by sending in orders which constantly grew in volume. In each case he paid on the day required and also sent along a fresh and bigger order. After he had got the jobbers and manufacturers convinced that he was "good pay" and had a business that was expanding, the swindler invariably sent in the biggest order of all, three or four times as large as any preceding bill. Then he packed the goods, shipped them to some secret place of concealment and vanished. Mr. West got hold of the letters which this man had written to his various creditors and found in them the same peculiarities which existed in much earlier letters written by the notorious Gashie Stein. For one thing, Stein had the habit of typing out the day and date in full, thus: February Eighteenth, Nineteen Twenty-three. He was also deficient in commas and connective punctuation. He invariably wrote Yours Truly with a capital T. There could be no doubt. Besides, all the letters were obviously written on an old machine which Stein had carried about with him for years on his peregrine. He was eventually run down and the evidence of the letters convicted him.

The reader will find on these pages some samples of typewriting as submitted to a Congressional investigating committee by Mr. Carvalho some years ago. There had been a hot fight over the kind of submarine to be adopted and the appropriations to be allowed for their building. In the course of the contention two communications, both anonymous, had been sent out into the district of a Congressman who adhered to one of the inimical parties. Complaint was made that another Congressman had sent out these communications for the express purpose of slandering and defeating the other man. In order to establish this point, the original communications were examined and Mr. Carvalho reached the conclusion that they had been written on one and the same machine. He indicated its make and model. Search revealed that there was such a machine in the office of the accused Congressman and samples of writing from this typewriter were obtained. Carvalho then enlarged the originals and the samples. Next he juxtaposed words appearing in the originals and the other writing from the suspected machine. In this way he demonstrated, by means of the juxtaposed enlargements, that all the writing had been done on the typewriter in question and that the campaign of slander was either done by or with the probable knowledge of the accused member.

Questions of handwriting often play vital parts in the destinies of great families, where corrupt lawyers, scheming adventurers or criminals of even darker dye find some method of gaining a profit out of falsification. No more sensational case of this kind ever came into the courts than that which involved the legitimacy of all the children of the financier, Jay Gould. This case was tried in New York State in 1899.

A woman named Margaret E. Cody wrote a letter to George J. Gould in that year, stating that she had the evidence to prove that his father had married a Mrs. Angel in 1853, that a child of this union survived, that Jay Gould and Mrs. Angel had never been divorced and that the Gould children were, accordingly, illegitimate and not entitled to their enormous inheritances. A baptismal certificate and marriage papers figured in the case, as did an entry on the record book of a small church upstate. (Marriage licenses were unknown in 1853.)

The affair was, of course, full of sensational possibilities and gained immediate and enormous notoriety. The idea that all the members of one of America's richest families might suddenly be reduced to the status of illegitimacy and deprived of their riches was an all too honeyed morsel for the tongues of gossip.

Two criminal trials resulted. At the first there was a disagreement. But Mrs. Cody was again haled before a jury and it was shown, by means of expert testimony, that the ink of the church record was new, that the page showed erasures, that the signature was not that of Jay Gould and that forgery had been committed on all sides. Mrs. Cody was convicted and eventually admitted part of her responsibility for the plot.

Wills are and perhaps always will be the favorite target of the falsifier. Every year sees many surrogate trials in which the last testaments of wealthy men are attacked and forced into the hands of experts for opinions as to their authenticity. The fact that the makers of wills cannot raise their voices out of tombs and denounce the guilty seems to lead many falsifiers into this line of fraud and heartless deception. However, it is the extreme rarity for such forgeries to go undetected and such schemes to succeed.

No more striking case of a subtle attempt to profit by an altered will can be cited than that which had to do with the last testament of George P. Gordon, the rich inventor of the printing press which bears his name. Mr. Gordon died in 1878 at his home in Orange, N. J., and left a will which was ambiguous. The heirs accordingly made an agreement among themselves for the partition of the dead man's property and this compromise was approved by the court.

But before the formalities could be concluded there appeared upon the scene one Henry Adams, a retired obscure lawyer, who owned a farm near Rahway, N. J., adjoining a much larger property on which George P. Gordon had formerly made his home. It was known that about the year 1868 Gordon had lived on his Rahway place and been on friendly terms with Adams and his relatives. It was also known at the time that Gordon had considered buying the Adams farm for the purpose of enlarging his holdings. But he had subsequently moved away to Orange and the purchase had never been made. No doubt the inventor had changed his mind about it.

Now, however, came Henry Adams with a hand-written (of course) draft of a will which, he said, had been drawn by him for Gordon, at the latter's request, in 1868. The draft which Adams presented to the court was, by his own statement, an original rough draft and there were marked upon it many additions, alterations and emendations, all in red ink. Adams said that a clean copy, embracing the red ink changes had then been made for Gordon, while he, as attorney, had retained the corrected original. This bore the signatures of Gordon and those of Henry Adams as attorney and several of his relatives as witnesses. But Gordon's copy of this instrument could not be found and his heirs contested the probating of this rough draft. They suspected fraud and said Adams had a motive for presenting it, since it contained a clause by which the heirs were instructed to buy the Adams farm for $32,000. The property had never been worth that sum, it was contended. At the time of the contest, in 1879, it was shown that the farm was worth no more than $12,000. But Adams persisted, repeated that the will was genuine and insisted on the carrying out of the provision relating to his farm.

At this point the astute Dr. Carvalho was summoned and asked to put the Adams copy to a thorough test. He was furnished with many samples of George P. Gordon's genuine signature and with the true signatures of the Adams relatives who appeared on the will as witnesses. Carvalho examined these various signings and concluded that neither Gordon nor the relatives of Adams had ever signed or seen the paper. His opinion was that Henry Adams had done all the signing himself, using the authentic copies to guide him.

But the most striking discovery was still to come. Mr. Carvalho noted the interlineations in the suspected will and saw that they had been written in a peculiarly brilliant red ink, having a bronzelike lustre. He went for his chemicals in considerable excitement, conducted a careful analysis of the red ink and discovered that it contained eosine.

All old fashioned red inks were compounds in which the active color ingredient was cochineal, the dyestuff extracted from a cactus infecting insect of the same name. Cochineal was the basis of most red dyes, food colors and inks until 1874 and later. In that year the German chemist Caro extracted eosine from coal tar and soon used it for ink making. But the process of extraction was at first very costly and it was not until 1878 that the first eosine ink was offered in the American market. This ink was so much more brilliant, easy flowing and cheap than the old cochineal inks that it fairly leaped into popularity. But Henry Adams had, by his own jactation, written the Gordon will and the red interlineations in 1868—ten years before there was a drop of eosine ink in the American market! His claim was accordingly and emphatically tossed out of court and its perpetrator arrested for forgery.

Thus reads the story of disputed documents—just another phase of the constant battle being waged between the criminal and the forces of law and order. In this instance, however, it does appear as though the forces of law and order have the best of the argument in the long run.

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Fig. 1. Generating tubes of Kerrick Steam Generator surrounding feed-water and re-heater coils.

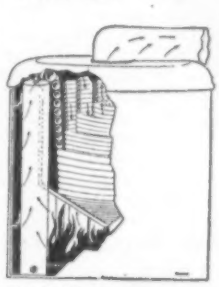

Fig. 2. Generator cut away to show location of feed-water and re-heater coils—also circulation of heat.

The Kerrick—easily cleaned—easy accessible—is adaptable to tractor, truck, or automobile.

Proved for four years by every conceivable test to be the most practical, efficient, and durable steam boiler for automotive use.

Fig. No. 1 shows the steam generating tubes, built around the fire chamber, designed to permit even expansion and contraction.

Fig. No. 2 shows direction of heat circulation (indicated by arrows). It shows the pre-heater or feed-water coil placed within the re-heater or steam-coil, thus the pre-heater controls or maintains an even temperature throughout the steam coil, by absorbing the excess heat regardless of variable loads.

Efficient and Easily Cleaned

The arrangement of the re-heater coil just within and adjacent to the steam generator tubes—and directly over the fire—assures an ample supply of dry steam.

All the foreign matter contained in the feed-water immediately upon entering the upright generating tubes sinks to the bottom of the tubes—below the fire level and out of the heat zone where it cannot bake or burn and is easily blown off.

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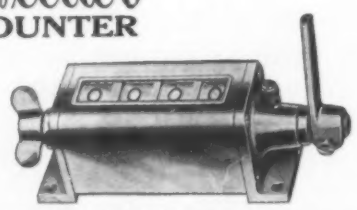
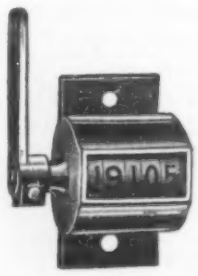
Veeder COUNTER

The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.





The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations, or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

There's a VEEDER to fit every machine—and every need in your development-work. The Veeder booklet shows 80 pages of counters; write for this free guide to greater production.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

Earthquakes and Volcanoes

(*Continued from page 305*)

set up loosely on their foundations and so put together as to permit a certain amount of swaying. Unfortunately these safeguards against earthquakes prove an aid to fire. Consequently American builders of recently erected steel-frame buildings in Tokio, which were especially constructed with a view to earthquakes, have been greatly delighted by reports that these structures have gone through the quake and fire with a fine showing, and they foresee a greater use of steel in future building in Japan.

In a seismic country, fault lines should so far as possible be avoided in the location of structures liable to damage. The Seismological Society of America has just issued a valuable map showing the location of faults in California. Special precautions should be taken in the location and construction of dams, bridges, aqueducts and water-mains; and proper provisions should be made for the prevention and extinguishing of fire.

Nearly every civilized country maintains an official seismological service, established in many instances after the people had been literally shaken out of their lethargy by a great disaster. In the United States, this work is carried on by the Weather Bureau.

Volcanoes

Volcanic eruptions are to the human mind perhaps the most impressive of geological phenomena. They may be explosive, quiet, or of an intermediate type. When violently explosive, they produce, in the main, solid fragmental material and gases (largely steam) are the chief factor involved. In a quiet eruption, flows of lava (liquid rock) make up the main product. Contrary to popular belief, there is little real flame connected with a volcano. The intermittent glow seen over a volcano at night, and the columns of "flame" seen issuing during an eruption, are due to the illumination of the clouds and vapors by the incandescent lava and glowing particles of rock.

Some volcanoes are more or less continuously active, with more violent outbreaks now and then, while others are nearly or completely quiescent for long intervals between eruptions. Many of the greatest volcanic mountains of the earth appear to be completely extinct, but sometimes a supposedly extinct one breaks out into eruption. In many volcanoes, during a quiescent stage, there appears to be a gradual accumulation of pressure. Lava rises in the conduit, and eventually an eruption begins explosively, great quantities of gases, mingled with dust and stones, being ejected. The pressure being thus to a great extent relieved, this phase is succeeded by a quieter one in which lava escapes through rents in the cone.

Probably there are about 400 or 500 active vents in the world at the present time, together with several thousand which are dormant or recently extinct. These have a general tendency to be grouped in long lines upon the earth's surface, following the zones of weakness along which movement and disturbance of the outer crust has taken place. The most marked of these is the veritable "circle of fire" bordering the Pacific Ocean. Most oceanic islands are volcanic.

The United States contains many interesting extinct volcanoes (Crater Lake, Oregon, occupies the crater of one), but very few have been active within continental United States (exclusive of Alaska) in historic times. Lassen Peak, Calif., has exhibited mild activity at frequent intervals since May, 1914.

Vulcanology is not so well organized nor so well advanced as seismology. However, a few observatories have been established to keep regular watch on volcanic phenomena (for example, on Vesuvius and Kilauea). In a a few cases fairly accurate predictions have been made of eruptions.

Famous Volcanic Eruptions

The most frightful of all explosive eruptions is said to have been that of Asama-Yama, Japan, in 1783. However, the best-known explosion was that of Krakatoa, in the Straits of Sunda, near Java (the greatest focus of volcanic activity on the globe), in 1883. After premonitory outrushes of gas for some time, there suddenly came a series of explosions which blew away over a cubic mile of the volcano. The vast dark cloud of dust and ashes rose 17 miles into the atmosphere, completely hiding the sun over a vast area. This dust was distributed over the entire globe by the upper winds, and was responsible for red sunset glows all over the world for many months. The terrific detonations broke windows 100 miles away, sounds were heard for 3000 miles, and the air waves generated traveled several times around the earth, as barograph records revealed. Waves up to 100 feet high rushed along the low-lying coasts of Java and Sumatra, sweeping far inland, and drowning 40,000 people. In a similar explosion of Mont Pelée on the island of Martinique, 1902, heavy fiery clouds of intensely heated gases laden with incandescent particles of rock rushed down the mountain slopes to the sea, and immediately destroyed the town of St. Pierre with its 30,000 inhabitants.

Perhaps the most remarkable volcanic area on the earth is the region surrounding Mt. Katmai, Alaska, the scene of a stupendous eruption in June, 1912, which spread desolation over an enormous area and darkened the sky for miles around the volcano, leaving in its wake the great "Valley of Ten Thousand Smokes" from which steam and gases are still escaping.

Vesuvius, the most-studied and best-known volcano in the world, is of the intermediate type, being in a state of almost constant mild activity, with now and then a violent outbreak, such as that of 1906. It is famous for the eruption of 79 A. D., in which Herculaneum and Pompeii were destroyed. Stromboli, in the Mediterranean, is in the same class. The constant illumination of its overhanging cloud provides a natural lighthouse.

Our Abrams Investigation

(*Continued from page 307*)

paper labels on the typewriter. Meanwhile, another member, aided by the doctor's assistant, the aforesaid Dr. Y, scraped off the hand-written, red-edged labels. The change was soon effected. Nevertheless, for some reason or other, the results were no more satisfactory than before, even though George, by "shorting" himself, indicated that he was bearing up well.

As a sort of check on Dr. X's technique, his assistant, Dr. Y, also took a hand at diagnosing. Unfortunately, Dr. X and Dr. Y did not obtain the same results, as for instance on tube No. 4, for which Dr. Y found streptococcus and tetanus both present, while Dr. X found neither. Dr. Y explained at this point that Dr. X, while an expert diagnostician in every way, works too fast and does not give the reagent time to return to normal in going from one "rate" to the next. She, Dr. Y, is forever cautioning Dr. X on point.

In going over the tubes again, after being told what they contained, Dr. X, working slowly and with more thoroughness, did find typhoid in tube No. 1 and streptococcus in No. 2 and tetanus in No. 4. The reactions were quite positive by now.

From time to time during the later part of the test, Dr. X requested that those present, and especially the reagent, keep their minds off the pure germ cultures which might be in the tubes. It seems that even the thoughts of those present have a serious electronic effect on the reagent and the accuracy of the diagnosis. Sensitive—super-sensitive, these reactions!

If the process is as delicate as all this, one begins to wonder how positive and accurate the electronic reactions diagnosis can be when dealing with the complex organism of the average patient, with a wide range of ailments to be differentiated. Especially does one wonder when two practitioners do not agree in their findings when dealing with such a specific thing as a pure germ culture. These results are quite different from the positive manner in which an electronic reactions diagnosis is conducted with the usual patient, and the findings tabulated in cold black-and-white charts.

Meanwhile, Dr. Abrams has extended to us his personal co-operation. He has promised to give us demonstrations while here in New York some time in the near future, if time permits. Obviously, Dr. Abrams is the leading Abrams practitioner. He has pointed out to us the danger of drawing conclusions through tests with persons who claim to be Abrams practitioners but who are not. Incidentally, Dr. Abrams has written to us, stating that Dr. X, with whom we had the test just described, does not represent E. R. A.—the genuine electronic reactions of Abrams—method. This fact must be taken into consideration, although we are beginning to wonder if this problem of getting in touch with genuine Abrams practice is not going to be an exceedingly difficult one. Dr. Abrams states that there are over forty bogus electronic reactions machines now on the market. All of which is highly interesting and must be duly considered.

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Electrical Notes

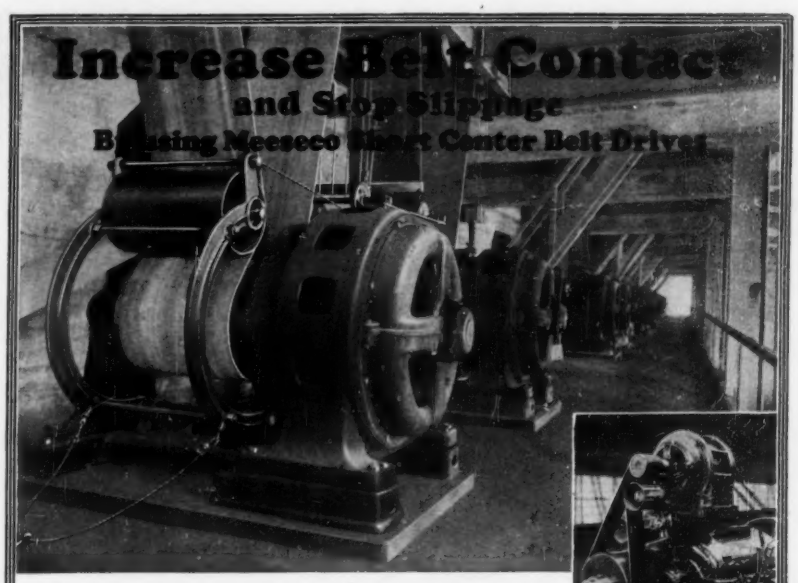
Wire Insulation Stripper.—There is now available a wire insulation stripper which will strip 1200 ends an hour in the hands of the average worker. It cuts and strips the insulation without nicking or fraying—instantaneously and automatically, like a pair of pliers, as fast as the user can close his hand. Anyone who has ever whittled the insulation from a wire end with a jack-knife or pulled it through a scraper will appreciate this simple little hand tool.

The Lighting of New York's Subway and Elevated Cars is an expensive proposition, so we learn from the *Electric Railway Journal.* It will cost $500,000 this year to light the subway and elevated trains, station platforms, track signals and other facilities of the Interborough Rapid Transit Company of New York. Of all the energy generated in its power plants, 6.6 per cent will be required for electric light. There are 320,000 outlets throughout the system, including those for 50,000 incandescent lamps in the subway cars and 88,000 on the subway platforms and in the tunnels. Ninety per cent of the last named burn continuously. The elevated trains require 45,000 lamps for lighting. Track signals account for additional thousands of lamps. Every 400 feet along the subway track there is a blue lamp indicating the location of an emergency switch for shutting off power in the third rail.

Sockets in Instalments.—In view of the present high cost of electrical supplies, we are apt to be quite curious when we learn that electric light sockets, among other electrical supplies, are being sold by one of the leading 5 and 10 cent stores. A study of the situation proves the truth of our source of information: sockets are being sold in such stores. But we also learn that the sockets are being sold, not in a single unit, as is the usual custom, but in instalments. Thus for 10 cents we can buy the cap and the shell, without the business part. For another 10 cents we can buy the "innards" of the usual socket. Hence for 20 cents we can buy a complete electric light socket. In view of the ingenious manner in which various devices are split up and sold in pieces so as to come within the hard and fast 10-cent limit, we like to speculate on how many parts will constitute a flivver when this popular article is sold in the 5 and 10 cent stores.

The Progress in Electrical Illumination was strikingly brought out by Messrs. J. W. Howell and Henry Schroeder in a paper presented at the recent annual convention of the American Institute of Electrical Engineers. It was pointed out by these men that if the present 40-watt tungsten filament lamp were made for the same average efficiency as Edison's bamboo carbon lamp of 1880, the tungsten filament lamp would have a life of more than 150,000 years. Taking into consideration the enormous efficiency gains in the large gas-filled lamps, the showing is even greater. It was brought out that the 40-watt lamp is now over eight times as good as it was when first introduced sixteen years ago. If we were using the old carbon filament lamp of pioneer days for our present-day electric light requirements, our annual costs would be increased by some three and one-half billion dollars. This would require about fifty million additional tons of coal, or about 10 per cent of the total coal production in the United States.

An Ingenious Variation in Automatic Telephones has recently come to our attention. It differs from the usual automatic telephone in that the subscriber gives his number to an operator in the usual telephone system, and does not have to work a dial. The operator, on the other hand, does not have to make the connection by means of plugs and jacks. Instead, the operator depresses keys not unlike those of an adding machine, as the exchange and the number are being given to her by the subscriber. As soon as the subscriber has finished his number, so has the operator made all the necessary keyboard manipulations and the connection is made. Comparative tests of this semi-automatic system and the full automatic seem to disclose several advantages for the former. In the case of small switchboards now in use, it may become possible to replace these with automatic switchboards controlled by one or two operators some distance away in a neighboring town which has a large central office. Obviously, it is more economical and efficient to maintain a large plant than a small one, and the operator need only have a few lines between her keyboard and the automatic switchboard in the crewless exchange some distance away.



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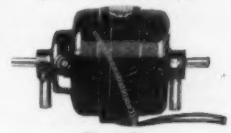

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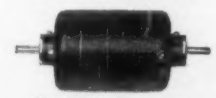

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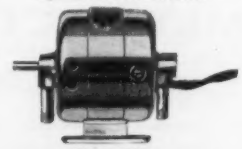

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GENERAL ELECTRIC

Within the Atom

(*Continued from page 309*)

But it is surely unlikely that it is really a compound of that kind; independent helion atoms are not likely thus to hang together. The atom of nitrogen may have a structure of its own, which is not really compounded of the elements into which it may nevertheless be broken up; any more than we need say that water actually consists of hydrogen and oxygen, though it turns into those gases, and nothing else, when decomposed.

It is perhaps a question of expression. Mr. Aston of Trinity College, Cambridge, has asked a corresponding and relevant question by the words, Does a pistol contain smoke? Some might say, yes, because smoke comes out of it when fired; others might say, no, the smoke is generated by the explosion and was not pre-existent. Neither statement need be false. But which is the more convenient?

Suffice it, therefore, to say that an atom of nitrogen can demonstrably be broken up into helion and hydrogen, but that what its constitution may be like before it is broken up is a question which awaits an answer.

What is certain in this experiment is that atoms of hydrogen are driven out. What is uncertain is what becomes of the rest of the nucleus. If it still clung all together it would be an atom of carbon, which would be unlikely. Most likely it breaks up into three atoms of helion. But other groupings can be suggested, and possibly the particular grouping may depend on circumstances. The evidence goes to show that hydrogen is certainly projected; and helion, probably. But it is a great experiment, for the disintegration of a chemical element had never previously been performed by artificial means. I do not say that nitrogen is the only one that has been dealt with, but I take it as the type. This breaking up of an atomic nucleus is a very recent discovery.

Has Sea Power Passed?

(*Continued from page 314*)

attacking planes one would need to carry enough bombs to surely sink 18 battleships. How many carriers would it take to carry that many planes, etc? Let one figure along that line and he soon sees what an expensive thing it would be to depend on Air Power alone rather than on Sea Power of which Air Power is an essential factor. Remembering that even the largest planes carry but one torpedo or one large bomb, it must be evident that to carry the necessary number of such missles to the fighting area there must be an enormous number of planes. Since not many large planes can be carried by any one carrier, the number of carriers will have to be great and the carriers must be large ships. Under the Treaty Limiting Armaments the signatory powers cannot build many large carriers. Under the circumstances how can a very large number of large planes ever be put into a fighting area at sea?

In short when we read the extravagant claims of the air radicals, one is reminded of Lord Lee's rebuke last March to a Member of Parliament who made an extraordinary statement regarding the prowess of airplanes: "Such a claim can only be described as rubbish and it is really trifling with Parliament and the country to make such statements, which are only calculated, without any excuse or justification, to undermine confidence in the Navy."

Great stress has been laid on the difference in cost between an airplane and a battleship. A fighting plane with engine costs about $18,000; a torpedo and bombing plane costs about $40,000; if we take the average cost as $30,000 and six months to build, there is an apparent advantage in favor of the airship; but it is only apparent, for the accessories which must go with aircraft, such as hangars, airplane carriers, shops, launching apparatus, flying fields, all cost many millions. Furthermore, the life of a battleship is 20 years, that of an airplane about two years. It is true that the crew of a battleship is 60 officers and 1200 men and that of a fighting plane five men, and for a scouting plane 12 men with one officer to each plane. A rough estimate for the number of men to maintain and care for 2000 airplanes would be 2500 officers and 20,000 men. There is nothing cheap about aircraft. But as Mahan says, "all this talk about the costliness of war is nonsense, except when one pays too dearly for the result, or the result is worthless."

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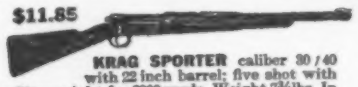

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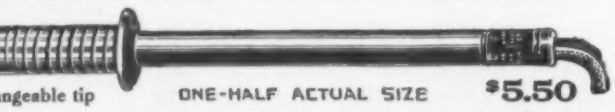

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unto the day." We have a few air squadrons and one dirigible. Admiral Moffett, the Chief of Naval Aeronautics, says, "In spite of the fact that the nations throughout the world are turning to air power for national defense, and bending every effort to develop aviation to serve them commercially, we, in America, unfortunately seem to suffer from a general state of apathy towards this great development. In fact our neglect of aviation will soon amount to almost a national peril."

Functions of Airplanes in War as an Adjunct of Sea Power. These are (a) reconnaissance; (b) spotting; (c) bombing; (d) blockading.

(a) As a scout the airplane is ideal, in clear weather. At an altitude of one mile, a large vessel can be seen 30 miles, the range of visibility varies, of course, with the size of the object and condition of the weather.

(b) With airplane spotting, fleets will hereafter go into action before sighting each other, and they will shoot accurately while each is below the visible horizon of the other. At recent long-range target practice in the Pacific, the "Tennessee" opened fire at 35,000 yards (17½ miles) and "straddled" the target on the third salvo at 32,000 yards.

(c) The restrictions of the airplane as a bomber have been described already.

(d) Airplanes if operating from carriers could materially assist a strong force of submarines in establishing a commercial blockade, but it would be quite impossible to blockade a fleet if the enemy were accompanied by submarines and aircraft of his own. In the North Sea the submarine failed as a blockader, neither the Grand Fleet nor the High Seas Fleet were kept in port by them.

"Let no one get the idea," writes Captain Harris Laning, U. S. N. (Staff of the Naval War College), "that aircraft have no place on the sea. They have a place, a place of vital importance, probably more important than that of any type of craft yet developed. Through them the whole scheme of getting and holding overseas lines has been changed. Possibly the developments of the future may prove that Air Power also includes Sea Power. But Air Power will not and cannot lead Sea Power as long as the present treaty limiting armaments remains in effect. As long as that treaty lasts, air forces must remain merely an adjunct of Sea Power, they cannot dominate it. What Air Power may be after the treaty expires we cannot predict; but there must be a great advance in air development before it drives out the *combatant* surface ships. In fact, those who give the most attention to the air problems find that while Air Power is a factor in Sea Power, Air Power is likewise *dependent* upon Sea Power. Those students who study and practice rather than dream and articulate, believe the two powers interlock and that each is a part of the other. Understanding the question better, they are endeavoring to keep the national defense on a solid foundation."

At the present time, there is nothing to indicate that Sea Power has passed away and is no longer the supreme defense of the country. It has, however, gained an indispensable and essential auxiliary, and linked with Air Power it will continue to endure until some remote period when Air Power alone may control the main highways of international commerce and communication. Not until then will Sea Power lose its present character and importance.

Materialized Hands

(*Continued from page 317*)

to the top of the ankle. The other was the mold of the lower part of the face of an adult. The upper lip can be seen, the lower lip, the depression beneath it and a bearded chin.

We examined the molds carefully; their bluish tint is exactly that of our paraffin, which I had colored a little more strongly before the experiment. Over and above this, we verified a fact which by itself would prove that the mold of a foot was certainly made in our paraffin. An excess of blue dye having been added and not entirely dissolved, there were in the tank in the lower parts of the wax some scattered crumbs of the colorant. And in the mold of the foot, at the level of the third toe, we could see one of these crumbs imbedded in the paraffin congealed above it. It was as big as the glass head of a large pin and of a deep blue color. The crumb is identical with those remaining in the tank. It had, therefore, been caught by the ectoplasm dipping into the wax and been incorporated in the mold.

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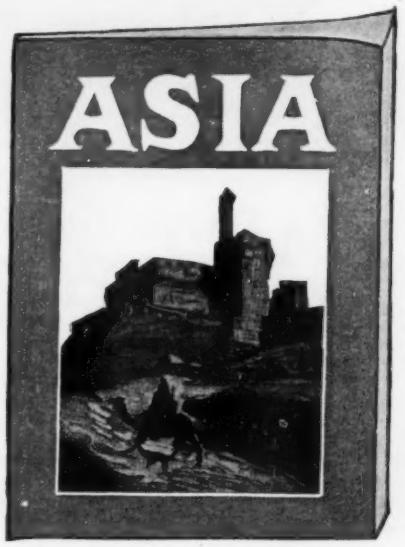

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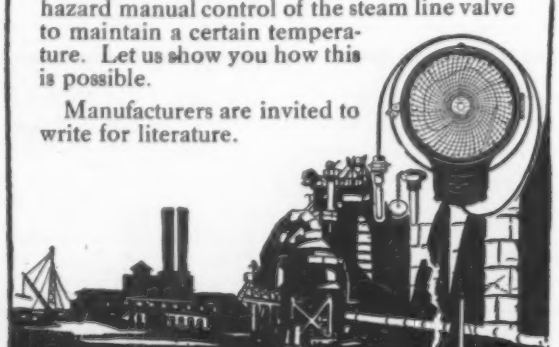

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vincing. But finally, after the experiment, immediately after the séance I took small pieces from the mold of the foot, put them in a test-tube and dissolved them in chloroform. On addition of sulfuric acid the red tint characteristic of cholesterin appeared, increased and gradually became darker. A parallel test with pure paraffin was negative, the wax remained white.

The proof, therefore, that the molds were made with our paraffin during the experiment, is absolute. We can affirm this categorically, basing the assertion not only on the detail of the mode of experiment, the precautions taken, and the evidence of our senses, but also on the blue coloration identical in the molds and the wax in the tank, the incidental inclusion of the crumb of coloring matter in the mold of the foot, and finally on the chemical reaction revealing the presence of cholesterin.

To sum up: We obtained molds of hands and feet of children, anatomically perfect, when there was no child present. The molds were produced with our paraffin during the séance. As the only possible fraud would have been that molds already made should have been brought in, we can affirm positively that our molds were of supernormal origin. There is also another proof, accessory but still important, of the authenticity of our molds. It is this: The casts of children's hands and feet which we have obtained all have the characteristics of the skin of an adult of a certain age. The medium is fifty years of age.

Nothing is more striking than the contrast between the size of these children's hands and the signs of age manifest in the furrows, the lines of the hand and the creases of the skin. This contrast had already been remarked on by Mr. Oxley, in a letter, February, 1876, to M. Aksakoff: "It is a curious thing," he wrote, "that in these molds the distinctive signs of youth and age are always found. This proves that the materialized members while keeping their juvenile form show particulars that betray the age of the medium."

It is easy to put together the complexities necessary to a fraud in the case of the molds we obtained. The implications would be the following:

1. The medium models, or gets someone to model, artistically, the hands of adults in different positions.

2. He gets some of these reduced in scale to the dimensions of children's hands. Such reduction is possible by the mechanical procedure of modern statuary; but it is nevertheless a job for an artist. One might also wonder at the absurd idea of not using the hand of a child instead of reducing that of an adult.

3. With the models so obtained he makes hollow molds, most artistically, so that the joints should not be observable.

4. Into the hollow molds he pours some substance, both fusible and soluble; for, according to the preceding there seems to be no other possible method, as far as can be imagined.

5. He dips these casts into hot paraffin, and then dissolves them out in cold water to obtain the residual gloves.

6. These gloves being extremely fragile by reason of their thinness, the trickster cannot think of bringing them in his pocket. He therefore places in a padded box the one or two molds to be exhibited at each séance. (It is highly probable that to perpetuate a fraud he would have been irresistibly impelled to make thick molds, easier to make, safer to handle, and less breakable.)

7. He conceals this box in a pocket so as not to be suspected. (This alone is a problem difficult to solve.)

8. At the experiment he adroitly frees one hand, gets at the box, opens it, takes out the molds and puts them on the table, splashes the paraffin and throws it about, puts the box back in his pocket, and replaces his hand in that of the bemused controller, who sees nothing of all this maneuvering!

Well! let us suppose all this farce successfully carried out, however complicated and unimaginable, what would have been the result? All this astounding skill and unheard of roguery would have come to nothing: it would have been unmasked by the unexpected control of the color and the secret admixture of the chemical, dissolved in the paraffin. Is it necessary to draw the inference? The conclusion imposes itself on every open-minded reader. There is no need to insist upon it. All the objections hitherto made have been frivolous. We have as yet waited in vain for any serious scientific discussion of our experiments.

I do not wish to close this article without a word on the philosophical deductions from ectoplasmic molds and ectoplasm in general. I must necessarily be very brief, referring such readers as are interested in the question to my book—"De l'Inconscient au Conscient." ("From the Unconscious to the Conscious." Translated by Mr. Stanley de Brath and published by Harper and Bros.)

For metapsychic science, materialization is no longer the quasi-miraculous manifestation described and discussed in old spiritualist books. It should be considered entirely apart from mystical theories or ideas, by proceeding from the known to the unknown; by seeking to understand what we do not know from what we do know.

What we know as regards ectoplasmic forms is that the materialized organ is a temporary creation dependent upon the organism of the medium. Proofs of this are super-abundant and leave no doubt whatever.

What we do not know is from what directing idea the materialization proceeds. Is it a matter of subconscious idea in the medium? Is there an extrinsic direction, such as that by a "spirit"? We do not know.

Nevertheless, in proceeding always from the known to the unknown we can base our notions on two sure observations: The subconscious is immeasurably vast; it contains faculties and knowledge unknown to the conscious mind, and even secondary personalities very different from the normal personality. And the subconscious has certainly a power of organizing matter, called the ideo-plastic power. Logically and if we are faithful to scientific method, we ought to explain all ectoplasmic manifestations and materializations by *the exteriorization of a part of the organism of the medium in an amorphous state and by the subconscious ideo-plastic organization of the substance so externalized.* This is, of course, only a working hypothesis. It seems very narrow to cover the whole of the known facts, and possibly may very soon be found insufficient. But, of course, it is for the present the only hypothesis conformable to positive scientific method.

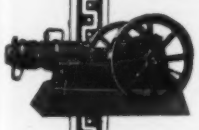
Let us make no mistake: this hypothesis, taken as it stands, is formidable. It revolutionizes entirely our classical concepts of matter and life. To give one example only—From the philosophic point of view, what does the notion of ideo-plasticity signify? It signifies that the idea can no longer be taken to be dependent on and produced by matter. On the contrary, it is the idea that molds matter, and gives to it form and attributes. This is the complete reversal of materialist physiology and the organo-centric notion of the individual.

A living being can no longer be conceived of as a mere complex of cells. It appears primarily as a *dynamo-psychism*, and the cellular complex which constitutes its body appears as nothing less than an ideo-plastic product of that dynamo-psychism. Matter counts for nothing, it is the idea that is everything here. To proclaim this truth that what is essential in the individual is not bounded by his organism, by its restricted senses, or by its limitations in time and space, it is to affirm, not as a mathematical certainty, but as the result of weighing probabilities, the pre-existence of the essential being and its survival of its bodily objectification.

Why Headlight Glare?

(*Continued from page 320*)

traffic regulations should provide for minimum road illumination consistent with safe driving as well as a maximum glare. They contend that headlight manufacturers can remedy matters very materially by equipping new cars with lenses and lens mountings in such a manner that they will fit together only when the lens is in a correct position. They suggest that some easily operable method of removing the lens should be perfected in order that the cleaning of the lens and reflector and the replacement of the bulb would be facilitated. Furthermore, an external focus adjustment should be provided in all headlamps. Very few drivers realize that it is necessary to refocus the lamps each time a bulb is replaced on account of the slight difference in positions of the filaments in different bulbs and the possibility of accidental change in position of bulb socket during such replacement. The lamp assembly should be made such as to positively locate the bulb reflector and lens with respect to each other so as to maintain this relative position. Headlamps could also be advantageously mounted so as to be protected from displacement by collision while appliances for swinging or tilting the lamps to correct for



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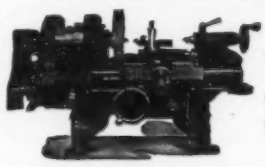

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The common practice of the average driver of switching off his bright lights in passing another car may prove dangerous on a dark road unless the car is being driven very slowly for it takes the driver's eyes an appreciable length of time to adjust themselves to the new conditions and until such adjustment is made, the driver is practically blind so far as seeing the highway ahead is concerned. Many drivers adjust their lamps so that they will throw considerable light up into the air possibly in order to better see highway signs. All such guideposts should be placed at heights at which they are readily discernible with headlamps that are legally satisfactory. The results of the Bureau of Standards' investigation of the headlight conditions of 400 average automobiles are appropriately summed up in Uncle Sam's conclusions: (1) Few motorists are gaining maximumly satisfactory illumination service from their headlights. (2) There is a real need for general public education regarding the necessity for and the means of adjusting headlights. (3) A test screen is simple and inexpensive and in general the required lamp adjustments are easily made. (4) The installation of an approved device does not in itself mean a safe or legal light. It must be kept in proper adjustment for satisfactory illumination. (5) Reducing glare with an approved device invariably results in more and better road illumination.

Ball Bearings and How They are Made

(Continued from page 331)

piece of silver steel, can detect instantly by the sense of touch the presence of any undesirable soft spots in the race. Suitable instruments are relied upon to establish whether or not the ball-track is true to form, of correct diameter, and placed exactly midway between the sides of the ring. Needless to remark, the ball-rack on the oppositely facing inner or outer ring must be concentric with its neighbor. Apparatus, based in principle upon magnifying calipers, give readings in ten-thousandths of an inch.

The balls in a bearing are held in their designed positions between a set of rings by means of what is known as a cage. Depending upon the type of bearing, these cages may be made of white metal fashioned by die casting or they may be worked up from brass tubing fed to automatic lathes. In either case, the product must be formed with due regard to exactness. The final operation in the manufacture of a ball bearing is to assemble its several parts. This would hardly be satisfactory if the rings, like the balls, were not nicely graded according to their refinements of size. This makes, in a measure, for what is termed "selective assembling," which assures perfection of fit and the utmost smoothness of running. These characteristics, in turn, contribute to long and successful service.

Keeping Our Water Fit to Drink

(Continued from page 332)

ber of organisms in the water through sedimentation, by the appearance of the organisms under the microscope—the coloring matter being knocked to pieces, so to speak. Sometimes there is an increase in the water bacteria which feed upon the decayed organisms. The Cyanophyceae may produce scum after treatment which is of varied colors, pale blue, yellow, red or brown.

The usual method of applying copper sulfate has been to drag burlap bags containing about 50 pounds each through the water by means of row-boats, taking a zig-zag course so as to triangulate the surface of the water. Wind, waves, diffusion and gravity admix the streaks of treated water with the remainder. It is remarkable how successful have been treatments made in this crude manner. On the extensive reservoirs of the watersheds it is necessary to use launches and in the last few years that portion of Kensico reservoir lying between the influent and effluent gatehouses has been successfully treated in two days' time with approximately 6,000 pounds of copper sulfate. This treatment has been made on several occasions at different seasons, including winter. On many other occasions 3,000 pounds have been applied to Croton Lake and once on Kensico reservoir. In these launch treatments of large reservoirs parallel courses about 100 feet apart are usually taken.

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an hour's flow above Kensico reservoir. The chemical feeds through a hopper to a moving shutter actuated by a motor and adjustable in stroke. The chemical drops through a wooden chute into a floating wooden crib bored full of holes. The electric feed originally designed for over 17 tons a day has fed 400 pounds a day within a pound error. No attention at night has been required. This continuous dry feed of copper sulfate to the water has been eminently successful. The dosage of chemical is definitely known and the application and admixture with the water thoroughly under control. At winter temperature 0.2 parts per million killed Asterionella and at spring temperature 0.12 parts per million.

The recent trouble with Synura deserves special mention. Experience with this organism goes back many years but the amount causing trouble was the smallest in that experience. The Brooklyn supply suffered from it many years ago and the Croton supply in 1900. On those occasions there were about 300 to 500 units. Synura has been present in Ashokan reservoir in all four years, 1918, 1919, 1920 and 1921, but up to last year the measures taken had been effective. It began to appear in August and was present in about 100 units by October. Watch was kept for it in the water entering Kensico reservoir but as it escaped discovery, it was assumed as in the experience of the previous years that it was destroyed by the Ashokan aerator and by passage through the miles of tunnel with its many invert syphons and particularly by the pressure of 700 pounds per square inch to which it was subjected in passing under the Hudson River. However, a sufficient quantity must have survived to seed Kensico reservoir and about 100 units became prevalent there by the middle of December. At that time complaints of fishy taste began to come in from upper Manhattan. The water had practically no odor but the taste was traced back to the chlorination plant. It was noticeable after but not before chlorination. The dosage of chlorine was 0.3 part per million, and the chlorine was killing the organism and setting free the oil. It happened that Hillview reservoir at the time was out of service. The first measure taken was to put Hillview into service, expecting in accordance with previous experience with other organisms that the two days' storage would remove the taste. It did not. In fact the taste passed through double filtration of sand and charcoal in the Municipal Building in lower Manhattan. As Kensico reservoir froze over in the sudden cold snap that occurred about that time it was impossible to treat the reservoir direct. Automatic treatment of the incoming water with copper sulfate was started at Pleasantville. Owing to the failure of Hillview reservoir to remove the taste, the next step was to bypass Kensico reservoir, since only about fifty units were coming from Ashokan reservoir. But the treatment with copper sulfate at Pleasantville followed by chlorination at Kensico brought out all of the taste of the organism so that a second wave of complaints swept over the city. The next attempt was to avoid destruction of the organism by stopping treatment with copper sulfate, shutting down the Kensico aerator and reducing the chlorine to 0.1 parts per million. This produced a nearly tasteless water at Hillview reservoir, but accumulation of the organism in local sections caused further complaints. The next step was to shift treatment with copper sulfate to Ashokan screen chamber. This was first tried experimentally for 12 hours so that if unsuccessful the treated water could be caught and held at Hillview reservoir. The object was first to learn whether the copper sulfate would kill the organism in the aqueduct in the absence of light and second whether the passage through the long 92 miles of aqueduct would remove the taste. Samples, of course, had to be accurately timed for flow in the aqueduct. After two experiments it was learned that 0.12 parts per million copper sulfate killed the organism almost completely at least 60 per cent, 0.18 parts gave similar results, but 0.25 parts completely destroyed the Synura and so quickly that the water was tasteless when it reached Hillview reservoir. Consequently treatment at Ashokan was started continuously with 0.25 parts copper sulfate and Kensico aerator put into operation again. Meantime it was learned that after killing the organism with copper sulfate, the chlorine did not increase the taste, hence dosage was increased to 0.3 parts per million again. Since then the water reaching the city has been without the cucumber flavor.

In order to learn other means of handling such a situation (which had a decided bearing upon the other large supply, the Croton), the next study was to increase the chlorine. As the apparatus was feeding its maximum at Kensico, the flow of water was cut down, running the excess into Kensico reservoir. It was found that 0.6 to 0.75 parts per million chlorine destroyed the taste and after 12 to 24 hours the chlorine could not be tasted. A similar experiment on a smaller scale was tried on the Bronx pipe line blowing off the water to the Harlem River, and it was found that 0.6 to 0.75 parts chlorine both killed the organism and removed the taste and yet the chlorine could not be tasted after flowing the 15 miles through the pipe line, time 15 hours. Following this experiment the pipe line was in service a week with chlorine dosage at Kensico dam of 0.6 to 0.75 parts without causing complaint in the city. As a result the chlorine equipment has been increased at Kensico so that the entire Catskill supply is now handled by this method. In the solving of the difficult situation created by the Synura, hundreds of samples were taken and tasted and it became necessary for Deputy Chief Engineer William W. Brush to assume personal direction of the extensive large scale experiments carried on.

Shifting Speeds with an Oil Pump

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ential gearing, when the speeds of the two road wheels vary, one of the motor units will receive a greater quantity of oil than the other, the sum total of the two always balancing the output from the pump. Thus the two motor units in themselves virtually constitute the differential. Although in the case of many appliances an equal speed is necessary in either direction, in the case of automobiles the reverse speed would, of course, be limited. It will be impossible to put the gear into reverse without first bringing a car to a standstill, skidding excepted. It is true that by tilting back the socket ring too quickly the gear would act as a powerful brake and cause the wheels to skid, but that would be the result of almost incredible clumsiness on the part of a driver.

Assuming that back-wheel brakes are still retained, they can be operated by a pedal, dispensing with the side brake shaft entirely, for it is obvious that the variable speed gear will serve the purpose of a powerful brake. The clutch, gear box, cardan shaft, universal joints and back axle gearing will become nightmares of the past. The driving of a car will resolve itself into the manipulation of a throttle lever and all clutching and declutching, gear changing and ordinary braking will be done by means of a small hand wheel or lever, requiring practically no effort. It is almost literally true to say that we shall have our fingers on the pulse of our engine. Another and by no means an unimportant feature is that most of the dirtiest work in attending to his car that now devolves upon the owner driver will be cut out of his program.

The Heavens in November, 1923

(*Continued from page 344*)

and practically invisible all this month. Could we but see him in the glare, we might watch him pass behind the sun on the day of conjunction, when he is actually concealed for several hours.

Venus is now an evening star, but poorly placed, near the sun and south of him, so that she sets before 6 P. M. even at the end of the month. On the 4th she is in conjunction with Jupiter, and less than a degree from him; but both planets are too deep in the twilight to be observable.

Mars is a morning star, rising at 4 A. M. in the middle of the month, but is still a long way off and correspondingly faint. Jupiter is an evening star until the 22nd, and a morning star afterwards, but is practically invisible. Saturn is a morning star, rising about 4:30 A. M. in the middle of the month.

Uranus is in Aquarius, and comes to the meridian in the early evening. Neptune is in Leo, and is observable in the early morning.

The moon is in her last quarter at 4 P. M. on the 1st, new at 10 A. M. on the 8th, in her first quarter at 4 A. M. on the 15th, and full at 8 A. M. on the 23rd. She is nearest the earth on the 8th (when we may look for high tides), and farthest away on the 21st. During the month she passes through conjunction with Neptune on the 2nd, Mars on the 6th, Saturn on the 7th, Mercury on the 8th, Jupiter and Venus on the 9th, Uranus on the 16th, and Neptune on the 29th.

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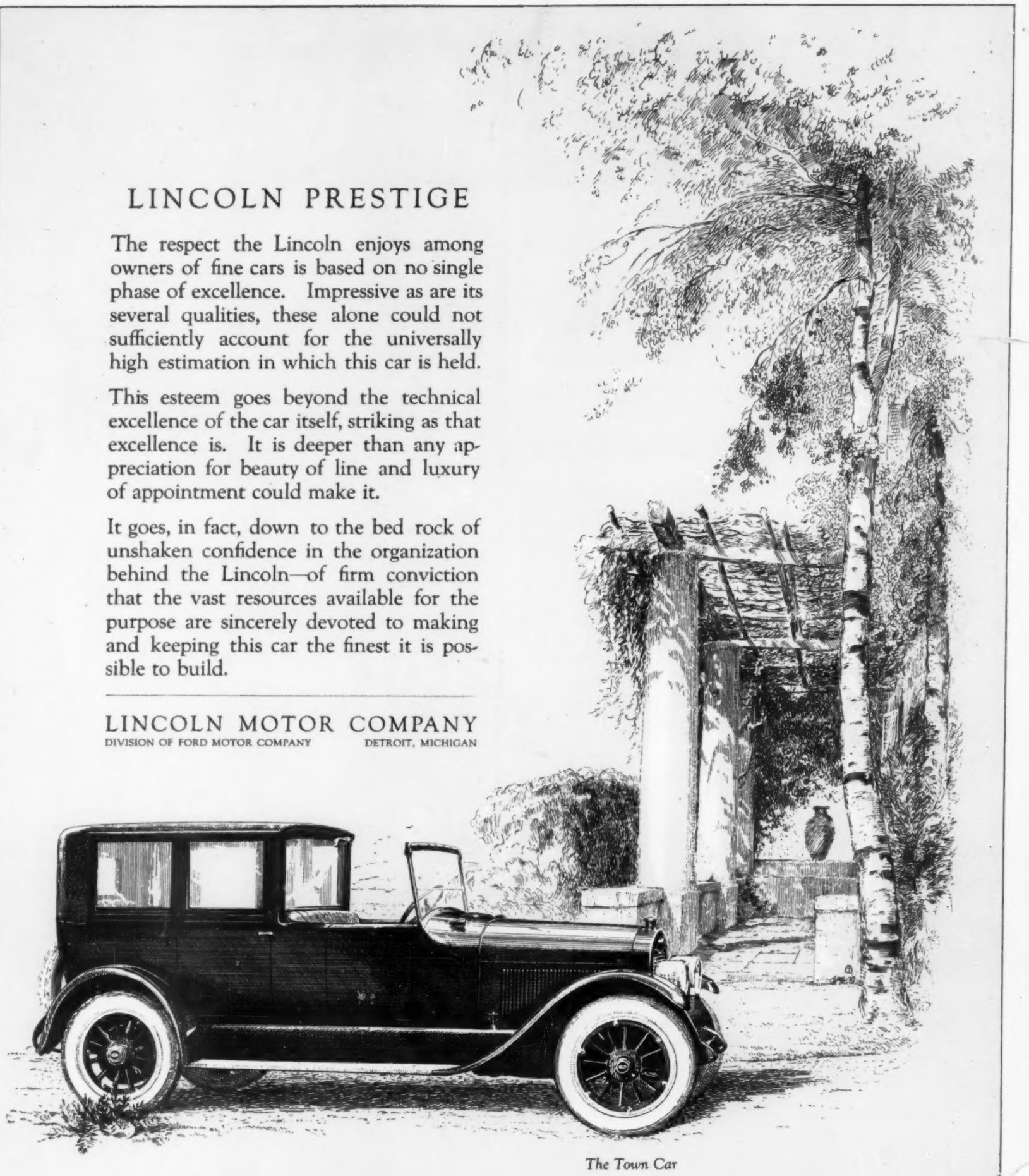

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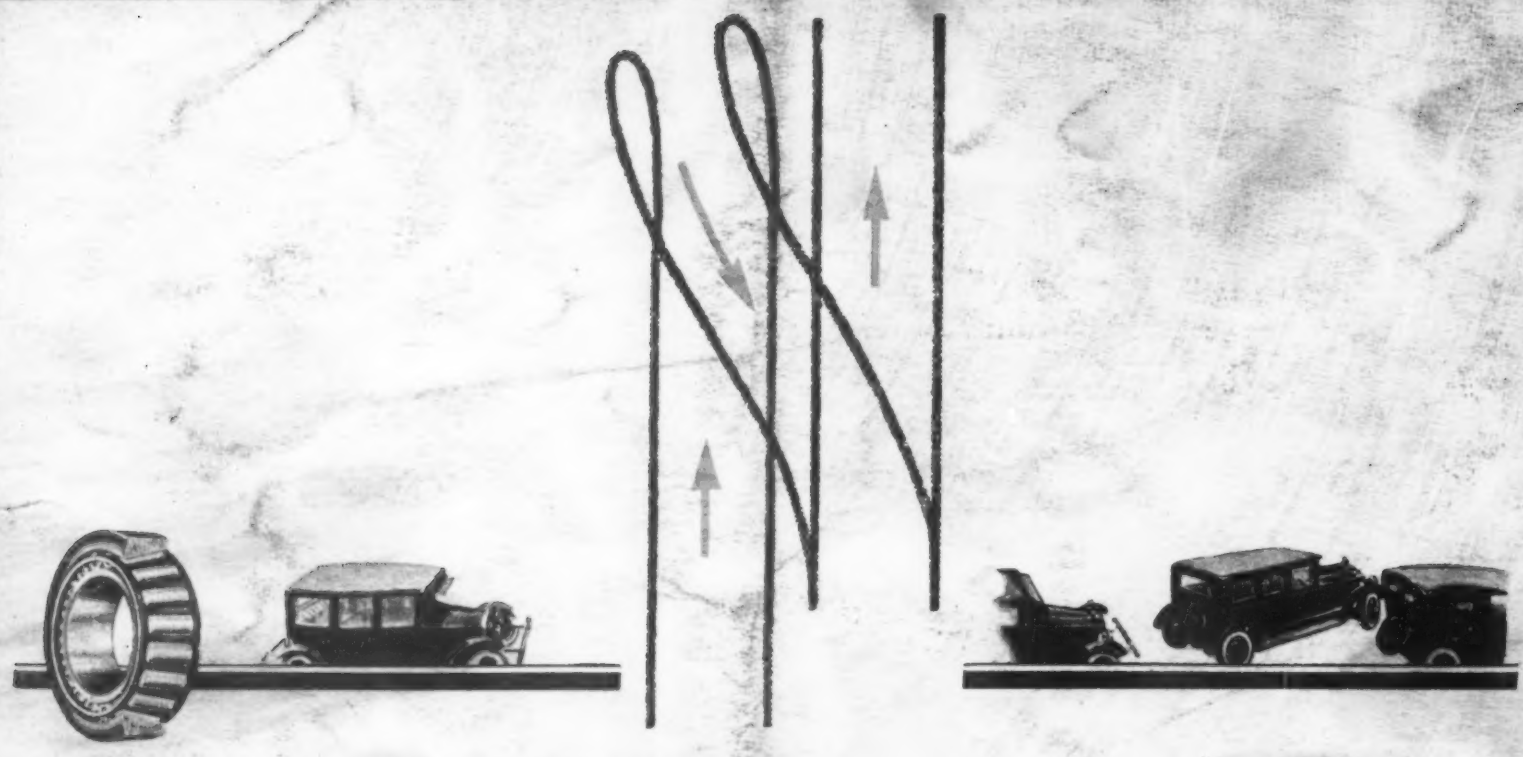

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